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Vol. xx JUNE, 1915 No. 6

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Published by THE COMPRESSED AIR MAGAZINE CO., Easton, Pa.

NEW YORK, Bowling Green Building LONDON, 165 Queen Victoria Street

Classified Buyers' Guide, Pages 14 and 16. Index to Advertisers, Page 8.

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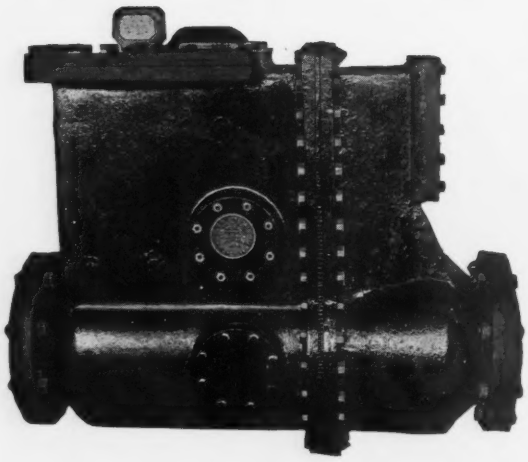

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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XX JUNE, 1915 No. 6

DRILLS AND DRILL BITS

BY CHARLES A. HIRSCHBERG.

In the early days of rock drilling a machine drill was considered satisfactory so long as it was capable of more rapid work than the man-and-single-or-double-jack." Subsequently as the possibilities of machine drilling were better understood, the demand on the drill became more and more exacting, until its manufacture has reached that final stage of perfection where it may be said to be no longer a question of further improvement of the drill design, but rather one of a better understanding of methods of handling, drilling the round and sharpening the drill steel.

Each has an important bearing, but it is the purpose in this article to deal only with the last mentioned phase of the question. The problem is at best a complex one, involving a study of the nature of the rock to be drilled; the method of attack or drilling round; the temper of the drill bit; the number of teeth or cutting edges; their shape and pitch.

The ground may be of a heterogeneous nature, of shattered formation, or of varying degrees of hardness, each creating a different problem, requiring special study to select the type of drill bit that can be employed most effectively. In other words, the degree of familiarity with the rock will determine largely the adaptability of the different types of drilling bits—hence the ultimate degree of efficiency to be secured from the drilling machine, irrespective of its type, style of mounting, or handling. However, it should not be overlooked that some types of drills have inherently higher drilling speed than others; therefore, maximum piston speed combined with the proper cutting bit will give the utmost cutting speed.

FIG. I. HAND ROTATED DRILL.

Therefore, greatest drilling efficiency depends upon the following factors:

(1) Knowledge of the rock.

(2) The selection of a machine drill that is suitable for the work in hand; whose dead time in handling and mounting is low, and that is capable of keeping pace with the drill bit.

FIG. 2.

(3) A study of suitability of drill bit.

TYPES OF DRILLS.

Hand-Hammer Class.—This class divides itself into two distinct types, the "hand-rotated" or plugger drill, and the "self-rotated" or Jackhamer drill.

Hand-Rotated.—Experience has shown that the "hand-rotated" drill (Fig. 1) is being confined to the drilling of comparatively shallow holes such as that required by "plug-and-feather" work, pop-shooting, etc., and even in this class of work it is rarely ever used where other requirements make it necessary to employ the "self-rotated" drill for other work.

The points in favor of the "hand-rotated" drill are: (1) Extreme lightness and absence of mounting. Weight ranges from 20 to 50 lbs. (2) Low air consumption. (3) Lower first cost. This generally is the determining factor with the small operator.

"Self-Rotated" — Jackhamer Type.— The "self-rotated" drill (Figs. 2 and 3) is used extensively for the drilling of down holes in shafts, trenches and road work, for taking up bottom, tunnel trimming, etc., and its record of performance is remarkable, as will be noted from some of the figures quoted further on.

The points in its favor are also: (1) Lightness and absence of mounting; weight ranges from 40 to 90 lbs., although lately machines have been developed and placed on the market weighing as little as 18 to 20 lbs. (2) Low air consumption. (3) Automatic rotation, relieving the operator of unnecessary labor. (4) Some effective hole-cleaning device is generally provided. (5) Rapid drilling.

SOME JACKHAMER RECORDS.

A few accomplishments are cited in the following: In the shaft of the American Zinc Co. an average of five Jackhamer drills sank a total of 284 ft. in 13 weeks, the drilling, shooting and mucking being started on Monday and completed on Thursday; the balance of the week being devoted to timbering. Size of shaft was 7x22 ft. Weekly average footage 21.9.

In one of the hoisting shafts of the Houston Colleries Co. at Carswell, W. Va., Walter F. Patterson, Jr., contractor, sank 253 ft. with three machines of this type during the period, starting March 2 and ending June 8. Weekly average footage was 18, which includes time timbering. Size of shaft overall was 24 ft. 4 ins. by 16 ft. 4 ins.

In the shaft of the Butte Alex. Scott Copper Co. at Butte, Mont., 101 ft. were sunk in 89 shifts with two such drills. Size of shaft was 7x14 each of two compartments. The upkeep expense in this case was but $2 per month per machine.

FIG. 3.

FIG. 4.

These performances are remarkable when compared with work accomplished with tripod drills which were formerly employed in this class of work.

Stoper Drill.—This type of machine (Fig. 4) for raising and stoping may be said to have a field distinctively its own. It is self-feeding up to the rock and is built both in "hand-rotated" and "self-rotating" types. Experience with the latter type has been comparatively recent.

The advantages of this type of drill for the work mentioned are: (1) Absence of mounting and ease of operation. (2) Rapid drilling. (3) It may be worked in very close quarters.

The record of accomplishment with the stoper drill in its special field has been all that could be desired. A few typical cases follow:

STOPER DRILL RECORDS.

One of the large Lake Superior mines recently drove 400 lineal feet of raise in a total of 50 shifts with two stopers operated by one man each. This work consisted in driving four raises of 100 ft. each. The ground was sufficiently hard so that timbering was not necessary other than occasional sprags by

FIG. 5.

means of which the men got to the working places.

In a test recently conducted on the Port Richmond tunnel job, California, a stoper averaged 70¾ ins. of drill hole in 19½ minutes.

The following case gives an opportunity for comparison between machine stoping and hand work covering a period of 3½ months in a total of 313 drill shifts: There were 16,431 ft. of hole drilled with four Butterfly drills, or an average of 52½ ft. per machine per day. The total cost during this period including wages of drill men, blacksmiths, timbering, blasting and a compressor man, and such miscellaneous supplies as coal, oil, gasoline and lighting was $3458.34 (Mexican currency), giving a unit cost of 10¼ cts. gold per foot of hole. The records of the company show that two operators with one double jack averaged 10 ft. of hole per day, for which a contract price was paid of 30 cents. gold per foot.

Mounted Hammer Drills.—In that class (Fig. 5) the market affords but one type—the "Leyner-Ingersoll" drill (excepting that lately the Jackhamer has been used mounted, for flat hole work), which has been successfully adapted for drifting and tunnelling, and as it represents a distinct departure from the generally accepted types of mounted machines a little historical sketch may not be out of place.

LEYNER DRILL HISTORY.

The Leyner drill was invented by J. Geo. Leyner, of Denver, Colo., and was the result of considerable experiment on his part, dating as far back as 1895, at which time he was manufacturing a reciprocating piston drill similar to that on the market at the present time.

There were several factors that induced Mr. Leyner to devote all his energies to the development of a successful hammer drill, in spite of the opposition which he knew would have to be met owing to the long prevailing usage of piston drills. One of these was the realization of the ultimate need for a light, easily handled and yet rapid drilling machine. His experience told him that this combination was not to be found by following prevailing designs, in spite of the fact that the experiments of other inventors with the hammer type of drill had not proved successful.

So far as the author is able to learn Mr. Leyner was the first inventor to adapt water to the drilling of rock through the medium of the machine itself, although the first Leyner hammer drill did not embody the water feature. The justification for Mr. Leyner's adherence to the conviction that the hammer drill has advantages that cannot be offered in any other type is shown by the widespread use of this drill.

Briefly its advantages are :(1) Ease of handling, mounting and chucking steel. (2) Rapid drilling for comparatively deep and large diameter holes. (3) The laying of the dust by means of the water feature and the admission of air and water to the bottom of the drill hole for cleaning purposes. (4) The permissibility of using it in close quarters.

The record of accomplishment is a long and successful one. An idea as to this may be gained from the following cases:

LEYNER DRILL RECORDS.

In a tunnel 12 ft. wide by 7½ ft. high carrying a drainage ditch 4 ft. wide by 2 ft. deep, driven for the Locust Mountain Coal Co., at Shenandoah, Pa., by Dolan Bros., contractors, a progress of 259 ft. was made in the first 14 days of October last, working three 8-hour shifts per day, and using two Leyner drills in sandstone—the last 14 days working in hard conglomerate rock, the progress was 254 ft. It will be noted that the hardness of the rock did not make much difference in the progress as the drills did practically as much work in both 14-day periods.

In the Cleveland Cliffs Iron Co.'s mines, the figures over a considerable period of time show 12 tons broken per man with this type of drill, as against 7 tons with a 3-in. piston drill.

In the Davidson Ore Mine Co.'s mine, working in iron ore, the average footage per drill is 117 ft., as compared to 59 ft. formerly obtained with a 2¾-in. piston drill.

The following are some of the tunnel jobs on which Leyner drills have been used and the highest progress attained in any one month on each job:

The above work represents practically every kind of conditions and rock encountered in tunnel and drift work.

ABOUT DRILL BITS.

With each type of drill mentioned in the foregoing, hollow steel is employed, and in the following are described some of the special conditions that have been met by certain de-

Name of Tunnel.	Location.	Size.	Highest Monthly Advance.
Central.....	Colorado	6'x9'	222 ft.—26 shifts.
Elizabeth Lake....	California	12'x12'	604 ft.
Hot Time.....	Colorado	5'x7½'	263 ft.—with 1 drill.
Joker.....	Colorado	12'x11'	282 ft.—2 drills.
Laramie Poudre....	Colorado	8'x10'	653 ft.
Lucania.....	Colorado	8'x9'6"	263½ ft.—29 shifts.
Newhouse.....	Colorado	6'x9'	290 ft.—30 shifts.
Rawley Drainage..	Colorado	7'x8'	555 ft.—26 days.
Raymond.....	Colorado	9'x9'	169 ft.—24 shifts.
Roosevelt Drainage	Colorado	10'x6'	435 ft.
Santa Barbara.....	California	6'x7'	439 ft.
Locust Mountain...	Pennsylvania	12'x7½'	513 ft.
Snake Creek.....	Utah	6'x9'4"	371 ft.
Rogers' Pass.....	British Columbia	7'x9'	851 ft.—31 days.

TUNNELS WHERE LEYNER DRILLS WERE USED.

partures from the standard drill bit practice:

Self-Rotating Hand Hammer Drill Operated by Steam.—In such work as shaft sinking in loose cavey material, some operators have experienced trouble due to the choking up of the hole in the steel and have employed the following means for overcoming the difficulty: A standard 6-point bit was altered as shown in Fig. 6. The hole in the steel, instead of being carried directly through the center of the bit, was punched through the side about ⅝ to ¾ in. above the cutting edge—the bit itself being forged solid, the hole coming out between the wings.

The clearance of the bit was also increased by cutting out the metal between the wings, back to the base of the bit or to the normal diameter of the steel. This reconstruction of the 6-point bit permitted it to accommodate itself to the water of condensation and mudding effects. Still another bit that was found of great service in almost identical conditions of drilling was a "V" shaped bit as shown in Fig. 7. The cutting edges consisted of two straight edges, meeting at a point and open at one side similar to a "V," the metal between these cutting edges being cut well back and the hole carried straight down.

Another illustration of the value of a bit specially created for the job is demonstrated in the sinking of a shaft in Colorado through sand rock and blue shale. This ground was found to give particularly bad mudding and had a tendency to cement. Various bits were tried and while it was found that the ordinary form of chisel bit with a single cutting edge

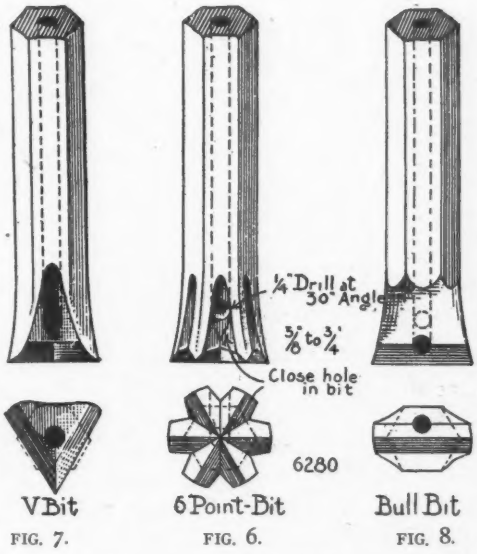


FIG. 7. FIG. 6. FIG. 8.

gave satisfactory results, further experiments led to a change consisting of carrying the hole in the steel out at the side (Fig. 8) instead of through the end. With multiple cutting edge bits it was found that the steel would jam in the hole and a great many holes and steels were lost, whereas the chisel or flat bull bit could readily be removed and drilled equally as fast in this rock.

James A. McIlwee in commenting on the results obtained by him with Jackhamers in the sinking of a shaft in Utah, stated, that if machines of this class are not mudding properly the difficulty can often be overcome if the op-

erator will occasionally raise the machine and steel so that the bit is about 6 ins. from the bottom of the hole; this will permit the air to blow through the steel and remove the mud from the bottom of the hole. Especially in drilling deep holes was this practice followed. He found that the "rose" or 6-point bit was a failure in this shaft, whereas a cross 4-point bit with a liberal clearance between wings turned the trick. The ground in this case was hard quartzite, and it was necessary to temper the steel in cyanide of potassium so as to protect the corners.

In further commenting on this job Mr. McIlwee stated: "We used four machines in sinking this shaft 500 ft. We had a 6-way manifold on the end of the air line, one for the pump, four for the drills and one for a blow pipe. An extra hose with a small ½-in. blow pipe 6 ft. long was kept in the shaft at all times, and when the holes were being drilled through ravelly ground, and the machines refused to throw the mud out, we would take the drill out and send the blow pipe to the bottom and give the hole a blowing out. By doing this for every 12 to 18 ins. we easily drilled 7-ft. cut holes."

The Use of Blunt Steel.—In the southwest there are a great many self-rotating hand-hammer drills operating by steam, in soft rock, and occasional trouble was experienced until a suitable bit had been found. In one very puzzling case where the rock was a very soft lime stone, 6-point bits were at first tried, but as satisfactory results could not be obtained, the standard 4-point cross bit was resorted to, and while considerable improvement was noted, it was felt that the results could be improved upon. The cross bits were made and then blunted to retard the cutting action and this successfully solved the problem. In rock as soft as that in question, sharp 6 and 4-point bits drill too rapidly, causing the cuttings to wedge around the steels just above the bits and interfere with rotation.

In drilling out an old concrete foundation containing about 2000 cu. yds. of material, the practice followed by a contractor was as follows: Holes were drilled to a depth of 30 to 36 ins. about 15 ins, apart, 15 ins. from the edge, 10 to 12 holes in a row. Two feet half-round feathers about ¼ in. thick were used and a 4-ft. pointed steel wedge about 1¼ ins. thick was driven into each of the holes drilled and slabs of concrete broken off. The wedges were driven in all at one time by men with sledges. Drilling was all done without change of steel and no special starters were employed. In starting this work "rose" bits were at first used, but as it was found that fragments of concrete and pebbles would wedge between the wings of the bit, and interfere with the free rotation of the drill steel; cross bits with broad exit passages between the wings were resorted to.

In the shaft of the Butte-Alex. Scott Copper Co. which was driven through hard and almost dry granite, 18 to 22 holes, 5 to 6 ft. deep, were drilled in 3½ to 4 hours' time, including the time consumed blowing holes out and blasting, and during March of this year, 101 ft. of shaft was broken, although operations were not conducted during 17 shifts of the month. Here difficulty was experienced in keeping the hole in the steel open, and the same method resorted to as that already described to overcome the difficulty. The hole was drilled in the hollow steel at a point 2 to 3 ins. above the end of the bit, and the mining company states that they are able to drill 7-ft. holes, and but very seldom experience trouble from plugged steels.

Punching the Hole in the Side of Hollow Steel.—Fig. 9 shows the manner in which the hole is punched in the side of hollow-drill bits and the style of punch used in doing the work. The punch if dressed as shown at the top makes the job easy of accomplishment and insures the closing of the hole in the end

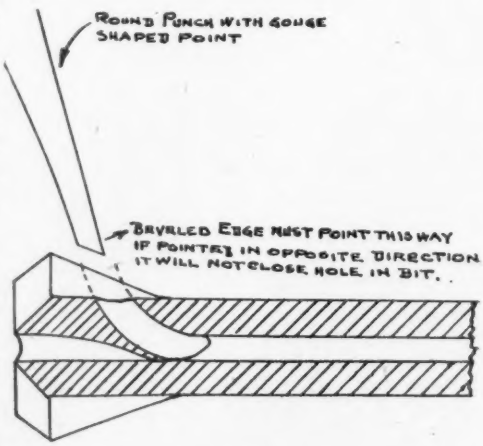

ROUND PUNCH WITH GOUGE SHAPED POINT
BEVELED EDGE MUST POINT THIS WAY IF POINTED IN OPPOSITE DIRECTION IT WILL NOT CLOSE HOLE IN BIT.

FIG. 9.

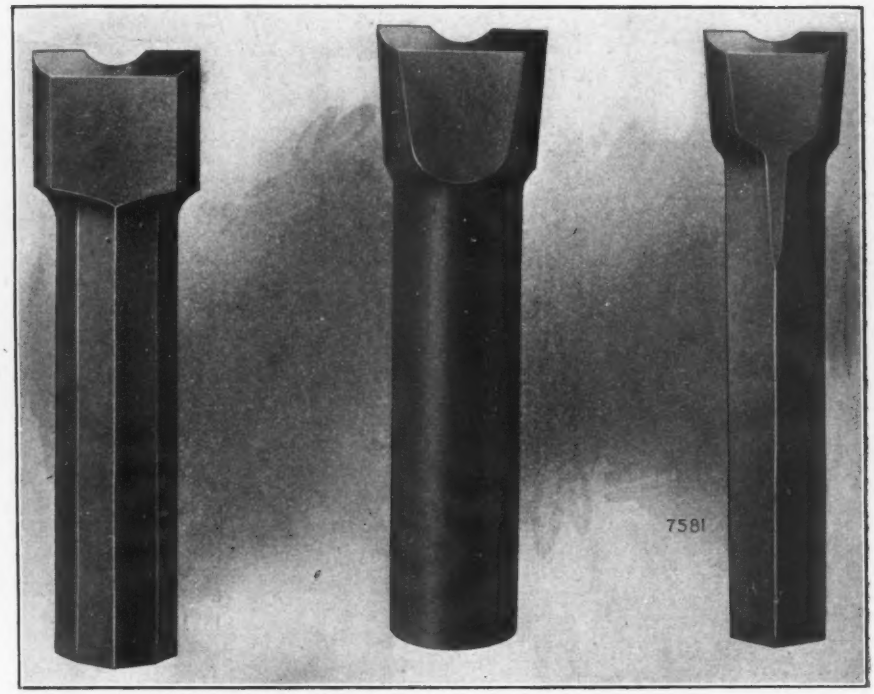


FIG. 10. FIG. 11 A. FIG. 11 B.

of the bit. The hole is punched part way and the punch withdrawn and cooled in water. It is then inserted once more and becomes sufficiently heated by the time it reaches the natural hole in the steel to take on a slight curvature. The beveled edge of the punch leads it into the hole as shown, forcing the metal just forward into the hole that leads out the end.

THE CARR BIT.

A recent contribution to the solution of the drill bit problem is that of the Carr bit. (Patents owned by the Ingersoll-Rand Co.) This bit while designed primarily for overcoming certain difficulties in drilling rock, has been found to meet satisfactorily, not only these special conditions, but the ordinary conditions as well. The Carr bit (Fig. 10) has but a single cutting edge and is uniform and symmetrical in shape. A transverse recess is formed across the center of the bit. With hollow steel this recess is tapered until it runs into the original hole through the steel. With solid steel the recess extends back about ½ in. from the face. This recess tends to act as a pilot, and reduces the cutting or contact surface with the rock to a minimum. The thickness of the bit is made equal to the short diameter of the steel and the length equal to the bit gauge. Hollow drill steel bits are conical in shape and have a 5° taper on a side (Figs. 11, 11A and 11B). Solid steel have straight, parallel, cylindrical sides (Figs. 10 and 12).

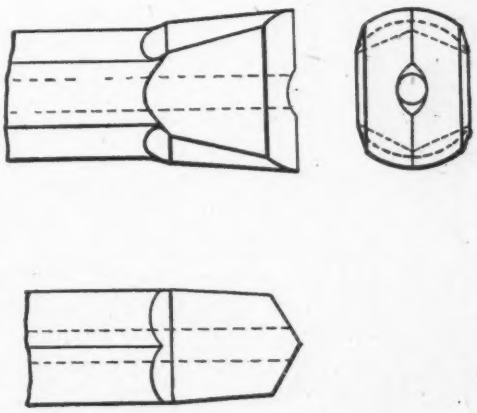


FIG. 11.

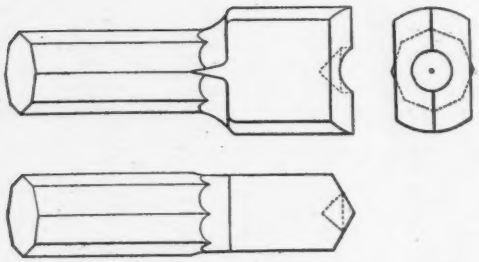


FIG. 12.

The advantages claimed for the Carr bit are: It holds its gauge better than the bits familiar to the trade; thereby increasing the depth to which a hole may be drilled before having to change steels. This reduces the number of steels dulled per shift. It drills a round hole and rotates easily. It does not require more than 1-16-in. variation in the gauge of bits on successive lengths of steel, thus avoiding the use of large diameter bits and therefore reducing the amount of rock to be cut. The bit is very simple in form and very easily made, either with hand tools or in the patented Leyner sharpener equipped with Carr dies.

The record of experience shows cases where holes have been drilled with a single Carr-bitted steel to a depth of 16 ft. through very hard rock, with soft seams running almost parallel with the hole being drilled, but with pitch enough to cross the line of the hole at a bad angle. The size of bit used was 1¾-in. on 1¼-in. round, hollow steel, and lost but very little of its gauge.

The idea of drilling a hole the same size from the collar down to the bottom originated with the inventor, from the discovery that a drill bit cuts a margin of clearance for itself, so that the problem became one of designing a bit that would effectually resist loss of gauge, would drill a round hole and cut rapidly.

To insure the drilling of a round hole the shape of the bit was made such that it would be imposible for it to go down if the hole were not round. The next problem was to overcome the loss of gauge. This was done by providing the long shoulders curved concentric with the axis of the bit. This combined with the other feature necessary in drilling the round hole formed a large area on the shoulders. The hole being round, and the bit being round, it simply rotates in the hole like a shaft in a boxing. Rapid cutting speed was assured by forming the tranverse recess in the centre of the bit, for the purpose of reducing the area that comes in contact with the rock.

After the above had been done, it was discovered that the harder the blow delivered to the steel and transmitted to the rock, the larger would be the hole cut by the bit. This was overcome by making the bit more blunt, or with less cutting edge pitch, and it was then discovered that the blunt bit would cut faster than the sharper pitch, as it would reduce the rock in the bottom of the hole by crushing a larger area and absorbing absolutely all of the blow to advantage, as there would be no slipping or sliding off of knots or lumps in the bottom of the hole.

A test of the Carr bit by the Alaska Treadwell Gold Mining Co. with a Bull Moose type of Jackhamer, as against the cross bit with the same machine, showed about 20 per cent more drilling for the Carr bit, while on the regular Jackhamer the Carr bit did about a third faster drilling than did the Cross bit under identical conditions.—*Mining World.*

AIR BLASTS IN MICHIGAN MINES

In our issue for January, 1912, page 6303, attention was called to the recurrence of violent and damaging "air blasts" in some of the deep copper mines of Michigan, especially the Quincy. It was assumed that these occurrences were due to the sudden displacements of large volumes of air, caused by the falling of great areas of the unsupported hanging walls in the old workings. Some doubts were suggested as to whether or not this dropping of the rock was the initial cause. Some of the shocks accompanying the blasts might be characterized as local earthquakes, the tremors in some cases having been noticed at distances of several hundred miles.

This matter is revived in the report of Mr. Charles L. Lawton, general manager of the Quincy mine, for the year 1914, and what follows is reproduced from that report.

On March 25, air-blasts occuring throughout the mine continued intermittently for a week or ten days. As a consequence, various crosscuts and drifts were crushed and closed up. No. 6 shaft-timbers were seriously crushed between the 51st and 58th levels, and No. 2 shaft was crushed and closed between the 40th and 50th levels.

About 500 ft. of the crushed section of No. 2 shaft had to be entirely recovered and re-

timbered at an expense nearly as great as that of sinking a new shaft. In the remaining portion of the damaged shaft, about half of the timbers were replaced. Excellent work was done, and a speed record made in recovering the shaft in the months of April, May, and June.

Below the 50th level, the shaft was not damaged by the air-blasts, though the cross-cuts at the 57th, 64th, 65th, and 66th levels were entirely closed, and the levels north were badly crushed. The 67th, 68th, 69th, 70th, and 71st levels north and south were not injured. The shaft has been entirely repaired and is now in good physical condition.

It was necessary to employ a considerable force of men for several months to renew and repair a large proportion of the timbers in the crushed section of No. 6 shaft, and to strengthen it by filling the old adjacent stopes with rock, while keeping the shaft in constant operation, in re-opening cross-cuts and drifts that were crushed, and in re-opening and re-timbering No. 2 shaft. Thus the cost of production was increased very much during the month following the air-blasts, especially because of the loss of three months' product from No. 2 shaft, and consequently the impossibility of operating the mine, railroad, and stamp-mills as economically at about 65% capacity.

In earlier days, when air-blasts were little understood, it was the custom to stope-out the lode irrespective of the shaft. If the lode was rich in copper, it was stoped-out close over or under the shaft; where the shaft was in the lode, the latter was stoped right up to the shaft without leaving shaft-pillars. Going through the upper portions of No. 2 and No. 6 shafts, is like going down through open stopes, with practically no pillars left to protect the shafts. It was in the lower part of these sections that the caving and crushing took place, with such serious results.

For several years there has been a rigid adherence to the policy of leaving increasingly larger shaft-pillars as the shafts are sunk, in order to sustain the litho-static pressure about the shafts. The air-blasts have never caused any damage to these sections of the shafts. At the present bottom of the mine, these pillars are being left 200 ft. each side of the shaft.

Air-blasts have continued with more or less frequency since July, though they have not damaged or retarded the work to any great extent. There were but three fatal accidents during the year, involving less than one-fourth of 1 per cent. of the working force.

In order to meet the air-blasts and prevent as far as possible the damages caused by them, as fast as the mining in each stope is finished, the bottom of the stope along the back of the level is filled with poor rock, constituting what is termed 'rib work.' Experience has taught that these rock-packs are the most effective means yet employed to lessen the damage caused by air-blasts.

After a careful investigation and study of the effects of the series of air-blasts that occurred in 1906, rib-work was employed for the first time throughout what were then the lower workings of the mine to combat the damages caused by these disturbances. For a number of years these rock-packs proved effective until the series of 1909. Again careful investigation and study readily showed that the rib-work was along proper lines, but had not been carried far enough. Therefore the packs were made deeper in the stopes, that is, doubled in size. For a still longer period of time these rock-packs proved sufficient, until March 25, 1914, when another series of air-blasts occurred. For the third time in has been shown that the rock-packs proved to be the best means of limiting such damage.

In order, however, that the highest effectiveness possible may be secured within the limits of profitable mining at greater depth, this rib-work should be still further strengthened. It is estimated that the voids in the rock give it a shrinkage of about 20 per cent. at the present depth of the mine. In order to lessen this shrinkage and strengthen the rib-work, the question of filling the voids with bank-sand, stamp-sand, or crushed rock is receiving serious consideration, inasmuch as provision must be made for better and stronger supports to the back of each level, as fast as stoping is finished. This must be done so as to avoid extended crushing, and thus guard the safety of the employees, minimize the losses and expenses caused by air-blasts, and make permanent the mine's future operations with depth.

During the year, $57,190 was spent for the recovery of the shafts and levels that were damaged by the air-blasts, and $21,487 has been expended in the fight toward preventing damages by air-blasts.

SOME JACKHAMER SUCCESSES IN ROCK DRILLING

BY CHARLES C. PHELPS

[The following article was first printed in the special "Success" issue of *Coal Age*, April 3, 1915, Ed. C. A. M.].

Three years ago the Jackhamer was unknown to the American coal miner. Today thousands of these little tools are in use in all branches of the coal industry—development work, shaft-sinking, stripping, driving gangways and cutting out seams of coal. They are also performing a multitude of other operations requiring the drilling of rock or coal. In this brief interval the Jackhamer has established for itself an enviable reputation in both the anthracite and bituminous fields as a mining tool of exceptional utility and efficiency.

It is probable that the miner first came to appreciate the value of the Jackhamer in connection with shaft-sinking. Some of its best records have been made in work of this character, and it is now looked upon as almost a necessity for this purpose. It works close up to the walls, keeping the shaft true to the required dimensions. It starts to operate without delay, whereas, in a crowded shaft, the mounted type of drill probably requires as much time to set up and adjust as is needed for the actual cutting. The steady rotation of the steel, the rapid blows on the drill and the constant blowing of the exhaust through the hollow steel, which keeps the drill hole free of cuttings, all tend to produce rapid penetration and to avoid troublesome delays.

SUNK 61 FEET OF SHAFT IN 17 DAYS

The records of performance best illustrate the successful achievements of the Jackhamer. A few typical cases follow. At the Bellevue Mines of the Delaware, Lackawanna & Western R. R. Co. coal department, Mike Hoban, a contractor, sunk 61 ft. of shaft of dimensions 12x14 ft. in hard sandstone rock in 17 days, working three 8-hr. shifts daily and using only one Jackhamer. This machine was in almost continuous operation, averaging 280 ft. of hole drilled per shift.

Dolan Bros. recently sunk a shaft 15x16 ft. at the mine of the Lytle Coal Co., near Minersville, employing two Jackhamers for that purpose. In four months' time, working through ground varying from very hard material to slate, they sunk 359 ft. of completed shaft, including timbering. There were three 8-hr. shifts per day and six days' work per week. These contractors say: "We have sunk many shafts of this approximate size with mounted piston drills, but never made the progress we have made in this one." The progress in the case cited figures to about 90 ft. per month. Their best previous record, using other types of drills, was about 61 ft. per month. They evidently entertain hopes of exceeding even this figure, for they state further: "If we had installed a sharpener at this job when we started it, instead of sharpening by hand, we believe we would have exceeded this footage."

SHAFT COMPLETED IN THREE MONTHS AND ONE WEEK.

Another interesting report is from Walter F. Patterson, Jr., of Pittsburgh, Penn. He sunk a shaft at the Houston Collieries Co.'s operation at Carswell, W. Va. The size of the shaft for the first 18 ft. was 30 ft. 4 in. by 22 ft. 4 in. Below that level it narrowed to 24 ft. 4 in. by 16 ft. 4 in., and continued with those dimensions till it reached the bottom at 253 ft. The monthly progress was as follows:

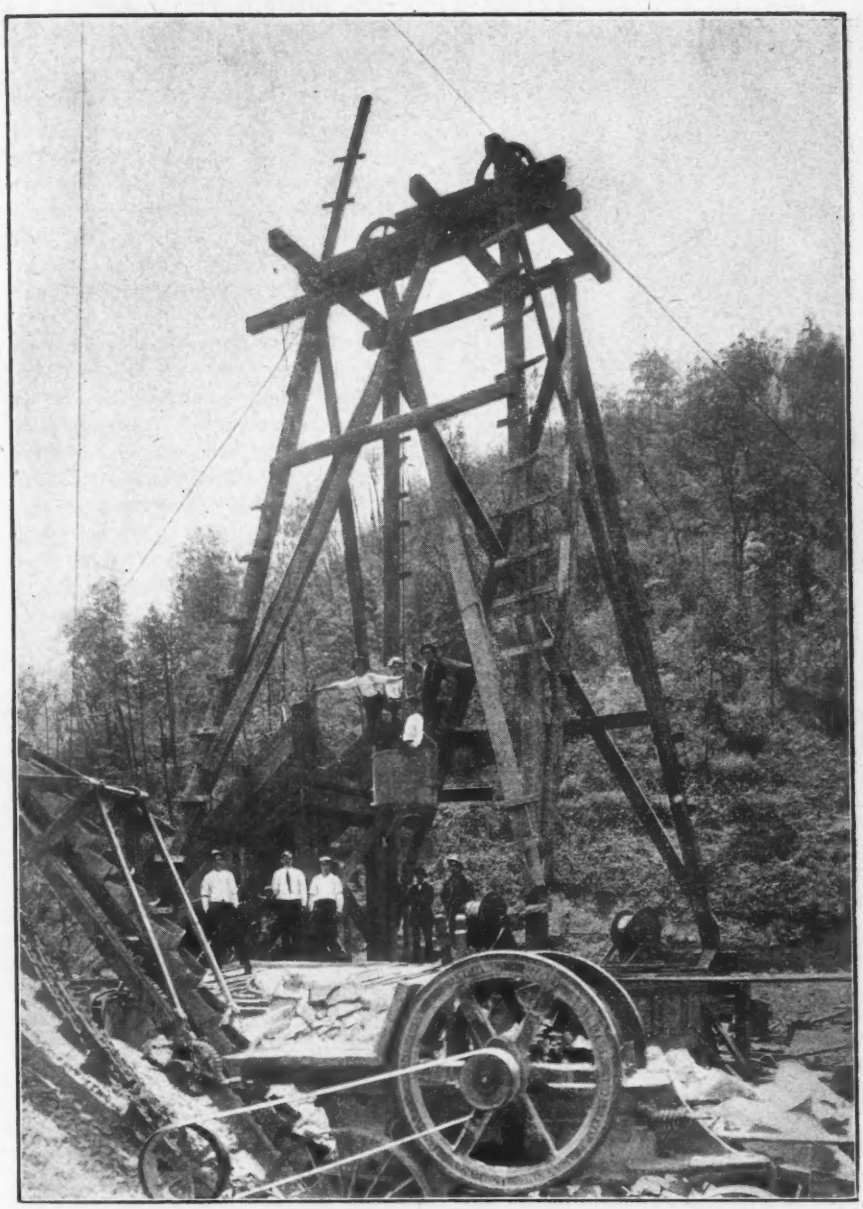
March, 1914	96 ft. excavation, 58 ft. timbering
April, 1914	86 ft. excavation, 53 ft. timbering, 1 water ring
May, 1914	54 ft. excavation, 109 ft. timbering, 1 water ring, 270 cu.yd. concrete
June (8 days)	17 ft. excavation, 33 ft. timbering, 4 strings, guides, brattice and stairs

Three Jackhamers were employed per shift on an average.

The weekly average was 18 ft. of completed shaft.

IN STRIPPING WORK STEAM CAN BE USED AS FURNISHED BY SHOVEL.

In all of the work previously referred to, the Jackhamers were operated by compressed air. They work almost equally as well on steam. This feature is particularly desirable in coal stripping, as the Jackhamers can be run by steam furnished by the steam shovel used in stripping. During some observations on the use of steam-operated Jackhamers for coal stripping in Kansas the operator drilled 14 one-foot holes in the sandstone cap rock in 20 min. In the coal bed, which is 4 ft. thick, several 4-ft. blast holes were drilled, the average time for completion being 3 min. each, whereas it required an average of 20 to 30 min. to accomplish the same result by hand. The exhaust steam kept the hole as clean of cuttings as if compressed air had been employed.

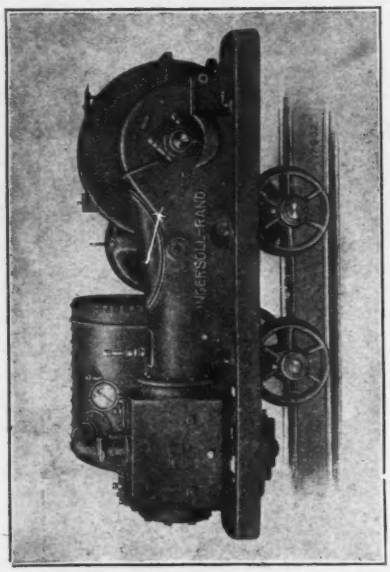


HOUSTON COLLIERIES CO.'S SHAFT AT CARSWELL, W. VA.

USING THE HAMMER DRILL IN AN ELECTRICALLY OPERATED MINE.

The development of the electrically driven mine-car compressor has greatly broadened the field of usefulness of pneumatic coal-mining machines for underground operations and this applies especially to the Jackhamer.

Several other electrically equipped mines are adopting the same method for drilling blast holes in both rock and coal. It is a simple matter to move such units from place to place in a mine wherever they may be needed. They are run over the regular mine tracks, derailed wherever desired and placed to one side. It is a simple matter to connect them up electrically, and they require little atten-



MINE CAR COMPRESSOR.

tion to operate, being self-regulating, self-lubricating and having a hopper type of water-jacket that requires refilling only at intervals of several hours. The compressed air leaves the compressor in a somewhat heated state, which is a source of economy and avoids all necessity for a reheater.

SERVES WELL FOR DRILLING COAL.

There is scarcely a substance known that the Jackhamer will not penetrate with ease—from the hardest granite to the softest coal. The same steel may be used for penetrating different materials, although larger-diameter steels are usually employed in drilling coal. "The Jackhamer is capable of driling in either coal or rock, which makes it a much handier tool around a mine than the ordinary coal auger," writes W. B. Earnest, of Cordova, Ala., who has been using the Jackhamer in the Indian Head Mines.

He continues: "It is so far ahead of the coal auger as to make the odds ten to one. In using this Jackhamer drill you do not know when you strike a sulphur ball, whereas with the coal augers you readily know it, as you will have to replace your auger because the points break when the sulphur ball is encountered." In boring coal for blasting Mr. Earnest uses a 6-ft. steel with a bit of large diameter and runs it straight in without changing steels and without any support for the Jackhamer other than the hands of the operator.

TWO FEET OF HOLE PER MINUTE IN HARD COAL.

In the St. Clair Division of the Philadelphia & Reading Coal & Iron Co. the Jackhamer was observed to drill very hard coal at the rate of 2 ft. of 2-in. hole per minute, using twisted steel and a 1¾-in. sheep-nose bit. This type of bit worked without raising any dust, which was particularly appreciated by the drill runners.

In telling of its experiences with the Jackhamer the Rex Coal Co., of Kitts, Ky., states: "We have a hard sandstone top and with this drill we can put up a 6-ft. hole in from 15 to 18 min. Before we got this drill we were paying $4 per yard for entry work; now we pay $1.75 and drill the rock, which makes a total cost of less than $2 per yard. The Jackhamer is the finest thing we have ever seen in the way of a drill. One man operates it and doesn't use any support for it at all."

DRILLS WITHOUT MOUNTING.

The few cases cited in the foregoing paragraphs will enable one to appreciate the reasons for the success which the Jackhamer has achieved in coal mining. The ordinary mounted drill would be quite out of the question for drilling blast holes in coal, for more time would be wasted in setting it up than in drilling. The Jackhamer, on the contrary, can be kept cutting nearly one hundred per cent. of the time if desired. For the same reason it has supplanted the mounted type of drill for cutting rock and is used for this purpose in many coal mines.

It strikes many hundred blows per minute, which is the principal reason for its great cutting speed. It is a popular tool with the miners not only because it enables them to increase their production but also because it is an easy matter to manipulate it. Weighing only 40 lb., it is as easy to use in drilling a "flat" as in sinking a "down" hole; and in fact it is occasionally used for drilling "up" holes. The Jackhamer requires little physical effort on the part of the runner, as it is merely necessary to apply it to the desired spot and guide is as it cuts. The Jackhamer drill is manufactured by the Ingersoll-Rand Co., of New York City.

A GAS ENGINE DRIVEN NATURAL GAS COMPRESSOR

One of the most interesting of the many engineering features of a natural gas transmission system is the compressor station, where the pressure of the gas is raised sufficiently high to furnish the desired volume to the most distant point of distribution. Experience early demonstrated the natural or rock pressure of the wells in gas fields to be unreliable under variable ranges of consumption and weather conditions. So in order that an adequate supply may be always at hand over the entire system under wide ranges of consumption, it is necessary that the pressure throughout the lines be maintained constant and uniform. This is done by putting the gas through compressor cylinders, and the type of machine now generally used for this purpose is shown in the half tone on this page.

This compressor consists of a gas engine with gas compressing cylinders directly connected to the front end of the bed. It is one of three units of the same general type in the plant of the Medina, Ohio, Gas and Fuel Co.'s compressor station, at Mansfield, Ohio. The Medina Company obtains is gas from the Ashland and Wayne County (Ohio) gas fields, and supplies a number of cities, including Mansfield, Lima and St. Mary's, and intermediate towns along its 150 miles of main trunk lines. More than 22,000 customers are supplied over the entire territory covered by the company's distributing system. No expense has been spared in the equipment of the compressor station and the distributing system to provide every possible safeguard for the protection of their customers against shortage or shut-off of gas supply.

The gas engines were built by the C. & G. Cooper Co. of Mt. Vernon, Ohio. This construction of driving the compressor cylinders direct coupled to the engine piston rods at the front end of the engine beds has become an accepted standard in compressing work.

The station contains two single tandem engines of the horizontal double-acting type, having cylinders of 21½" diameter and 36" stroke, each rated at 480 brake horse power; also one twin tandem engine having the same size cylinders, rated at 960 brake horse power when operating at 125 revolutions per minute.

The compression is accomplished in two stages. The twin tandem drives two 30¼

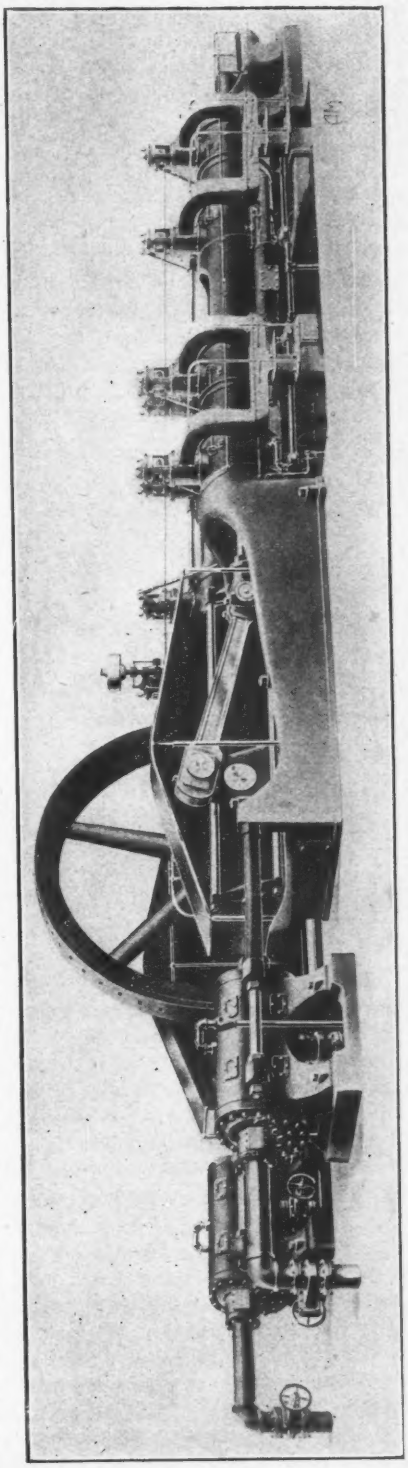


FIG. I.

hurricane type Ingersoll-Rand cylinders, which compress the gas through the first or low pressure stage. These cylinders are designed to deliver about 15,000,000 cubic feet of free gas per 24 hours at 10 lbs. suction pressure, and deliver the gas to the second or high pressure stage, at about 60 lbs. pressure. The two single tandem units each drive a 15¾" high pressure Hall compressor cylinder, which receives the gas from the low pressure stage at about 60 lbs. pressure, and discharges it to the pipe line at about 200 lbs. pressure. The two cylinders have a combined capacity of about 12,000,000 cu. ft. of free gas per 24 hours.

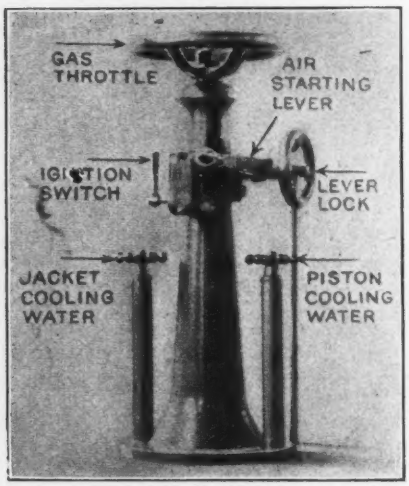


FIG. 2.

The simplicity of starting and stopping these machines is a feature. Fig. 2 shows the floor-stand throttle or operating center. The gas, the air-starting and the water valves, as well as the ignition switch, are all located on this stand. To start the engine it is only necessary to open the compressed air valve which "cranks" it. The gas valve is then opened, and as soon as ignition takes place in the cylinders, the pressure air automatically is replaced by the regular explosive mixture, and the air starting valve automatically is thrown out of service when the air valve on the throttle stand is closed. Two valves on the floor stand throttle control the water circulation, one the jacket cooling water which passes first through the exhaust valve chambers, then through the cylinder jackets and out to the overflow pipe. In the latter system, after passing through the cylinder heads, the water enters the piston rods at the intermediate cross-head, flowing in opposite directions, and passing out through outlets provided at the main and rear crossheads. This arrangement of cooling serves to maintain uniform temperatures in each cylinder, each piston rod and each piston. The gas and air piping is arranged so as to provide a stairway and platform for the convenience of the operator in inspecting and oiling the inlet valves and gear.

TESTING THE SENSITIVITY OF DYNAMITE

A question having arisen recently between a mining company and a powder company regarding the quality of the gelatin furnished, the manufacturer sent a representative to investigate. A test of the sensitiveness of the powder was conducted as follows: A stick of the gelatin was cut in halves and into one half was inserted a cap and fuse. A paper tube was made by rolling a piece of ordinary letter paper about the stick so that the two halves were 12 in. apart end to end, after which the fuse was lighted. The explosion of the primer-half did not explode the other half of the stick but blew it about 15 or 20 ft. away and left it frayed up and looking like a sponge. A second stick was similarly cut, rolled and fired, the distance between the two ends being 5 in. The result was practically the same. A third stick was cut and similarly fired, the two ends of the cut stick being 2 in. apart, and in this instance the primer half exploded the other half of the stick.

This test proved to the mining company that the gelatin was no good, inasmuch as it was so insensitive to shock that half a stick of the powder with a strong detonating cap would not shoot off another stick of the same gelatin until it was within 2 in. of it. The test proved to the powder representative that the powder was all right, because if it would explode a stick 2 in. away from it, it certainly would explode a stick touching it, which would be the case in a loaded drill hole. Thus was demonstrated the sensitiveness of the powder to detonation, the sensitiveness of the manufacturing company to criticism, and the sensitiveness of the mining company to conviction. —*Mining Journal.*

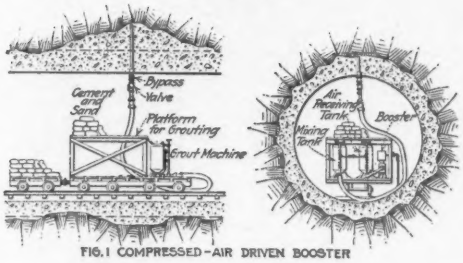


FIG. 1 COMPRESSED-AIR DRIVEN BOOSTER

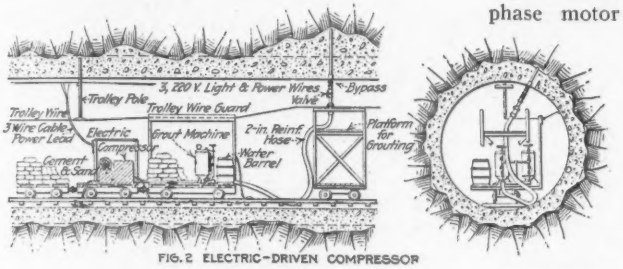


FIG. 2 ELECTRIC-DRIVEN COMPRESSOR

on trucks in the tunnel and moved along with the work. Fig. 2 shows a type of equipment in which the low-pressure grouting was carried on as usual with the air furnished from the surface compressor plant, but the high-pressure grouting was done with the small compressor driven from the lighting or power circuits.

Still another style of equipment is shown in Fig. 3. Here a 20-hp. Westinghouse three-phase motor drives a two-stage Ingersoll-Rand belt driven compressor at 210 r.p.m., delivering 129 cu. ft. of air per min. at a pressure of 350 lb. per sq. in. A 7½ hp. motor of the same type as the larger one drives a double acting geared McGowan pump, delivering 50 gal. of water per min.

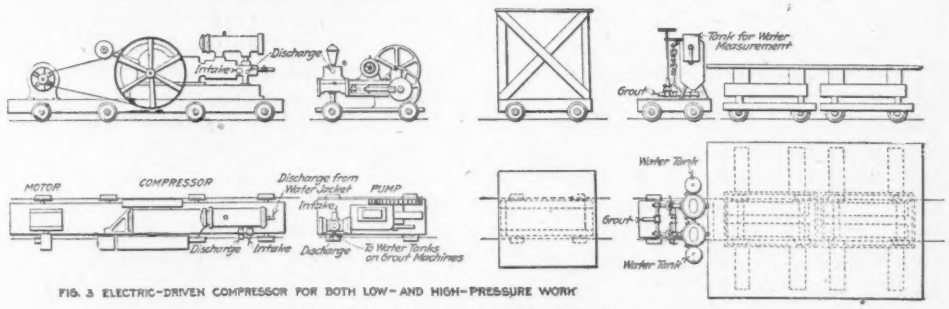


FIG. 3 ELECTRIC-DRIVEN COMPRESSOR FOR BOTH LOW- AND HIGH-PRESSURE WORK

COMPRESSOR AND GROUTING OUTFIT.

DIFFERENT COMPRESSORS AND GROUTING OUTFITS FOR CATSKILL AQUEDUCT

BY WALTER E. SPEAR.

The accompanying illustrations show the equipment employed in grouting the City Tunnel of the Catskill Aqueduct. Fig. 1 shows the arrangement of plant commonly used on the Catskill Aqueduct, which was adopted in some sections of the City Tunnel. Air piped from the compressor plant on the surface was delivered directly to the grout tanks at pressures of 80 to 100 lb. per sq. in. for the low-pressure work. When the grouting required higher pressures the air was further compressed to 200 or 300 lb. per sq. in. by means of an auxiliary air-driven compressor or "booster," supplied from the compressor at the surface.

On several sections of the City Tunnel compressed air was furnished for the grouting by small electrically driven compressors mounted

With this plant both the low-and high-pressure grouting was done with the electrically driven compressor in the tunnel. The adoption of this equipment, in which the compressor in the tunnel could be operated only when grouting was actually being done, made unnecessary the more or less continuous operation of the large compressor plant on the surface and effected a further economy in avoiding the piping of compressed air through the tunnel for the grouting work.—*Engineering News.*

The International Signal Company has brought out a device that automatically reduces train speed to any desired rate whenever a train approaches a switch or crossover, gives a short, sharp signal audible to crew and passengers, and automatically stops a train entering a block that is not clear.

SAND BLAST CONDITIONS FOR EFFICIENCY

BY JAMES M. BETTON.

No sand blast can work at best efficiency without an ample supply of compressed air carried at an even and steady pressure. The air must be free from oil and moisture, which will otherwise condense on the sides of the sand tank, run down and cake the sand about the sand valve besides, especially in the case of oil, clogging the air pipes.

The quantity of compressed air consumed by any sand blast is only the amount that is delivered through the nozzle, barring leakage. The size of the air inlet to the sand blast does not modify this, the quantity of air used is that which finally issues from the nozzle mixed with the sand. This applies to any make of sand blast.

The horsepower required to compress 100 cubic feet of free air from atmosphere to the various pressures, with one-stage compression, is given in Table I.

No allowance is made for friction of air in compressor or piping, for which 15 to 20 per cent. should be added.

To ascertain the power required to supply any sand blast with compressed air under a given pressure, multiply the quantity of air, in cubic feet, discharged per minute from a nozzle of the diameter selected, under the stated pressure, by the actual horsepower required to compress 100 cubic feet of free air, as shown, and add 20 per cent. for friction. This is worked out in Table II, which gives the quantity of air discharged through nozzles of various diameters under the usual limits of working pressures, 20 per cent. being added for friction.

TABLE I

Gage pressure, pounds.	Actual horse-power.	Gage pressure, pounds,	Actual horse-power.
2.....	0.93	55.....	12.67
5.....	1.96	60.....	13.41
10.....	3.60	70.....	14.72
15.....	5.03	75.....	15.37
20.....	6.28	80.....	15.94
25.....	7.42	85.....	16.50
30.....	8.47	90.....	17.06
35.....	9.42	100.....	18.15
40.....	10.30	125.....	21.00
45.....	11.14	150.....	24.00
50.....	11.90		

HOW THE SAND WORKS.

Regulate the flow of sand into the current of air so that just enough will issue from the nozzle to give a good cutting effect. The sand cleans an object by striking an infinite number of sharp blows on a small area, and not by the friction of the particles sweeping over it. Just enough sand will enable each grain to get in good work. Too much will cause the particles of sand to rub on one another and reduce their energy by the friction of their particles.

As a rule, hold the nozzle about 6 inches from the surface to be cleaned, at an angle of from 30 to 45 degrees. Use coarse sand in preference to fine, for general cleaning. It does quicker work with less dust and breaks into smaller particles which can be used again. Dry all sand over a fire, either on an iron plate, stirring continuously, or in a sand-drying stove. Sand that contains any moisture cannot be depended upon to flow from the sand tank by gravity. Do not use sand that contains clay, loam or burnt sand, all of which cause unnecessary dust in the cleaning room. Clay and loam can be washed out of the original sand, if better cannot be procured, and burnt sand sifted out by a double-decked screen. All sand should be run through a No. 8 mesh screen before being placed in the sand tank. Stones, chips, shells, leaves and paper will surely clog the nozzle and interrupt the blast, unless they are removed.

Make the air piping between the air receiver and the sand blast as short and direct as possible. Do not reduce it below the size the air connection calls for and, if the distance is over 75 feet, make it at least one size larger. This reduces the friction of the air in the piping and gives a volume of air behind the sand blast. Keep the air piping tight and protect it from the cold if it is exposed, preventing condensation. If the air is damp when it reaches the sand tank, use a moisture separator near the tank, or trap out the moisture from the bottom of a U-shaped bend.

If a pressure-reducing valve is used to cut down the air pressure in the sand blast, put a small air receiver in the air line, between the reducing valve and the sand blast, to give a good body of air behind the blast, as well as to condense moisture. Keep the pressure reducing valve clean and free from pipe scale inside, to obtain best results.

The air compressor should be of sufficient capacity and power to supply freely the quantity of air discharged by the sand blast nozzle under the selected pressure, and to maintain this pressure evenly. When you have determined the quantity of air needed, buy a compres-

TABLE II

CUBIC FEET OF FREE AIR DISCHARGED PER MINUTE BY SAND BLAST NOZZLES, WITH HORSEPOWER REQUIRED FOR OPERATION—20 PER CENT ADDED FOR FRICTION

Single Stage Compression at Sea Level

†Horsepower.
*Free air.

Diam. nozzle, inches.		Gage pressure, pounds. 2	5	10	15	20	25	30	35	40	45	50	60	70	80	90
1/8	*	2.435	3.86	5.45	6.65	7.70	8.60	10.00	11.20	12.27	13.40	14.50	16.80	19.00	21.20	23.5
	†	0.026	0.09	0.24	0.40	0.58	0.77	1.02	1.26	1.51	1.79	2.06	2.70	3.35	4.06	4.8
3/16	*	5.45	8.72	12.30	15.00	17.10	19.40	22.40	25.00	27.40	30.40	32.80	37.50	42.90	47.50	52.4
	†	0.06	0.20	0.53	0.90	1.33	1.73	2.27	2.82	3.42	4.04	4.68	6.03	7.57	9.08	10.7
1/4	*	9.74	15.40	21.80	26.70	30.80	34.50	40.00	44.70	49.00	53.80	58.20	67.00	76.00	85.00	94.0
	†	0.11	0.36	0.94	1.60	2.32	3.07	4.05	5.05	6.05	7.19	8.31	10.77	13.40	16.26	19.2
5/16	*	16.18	24.12	34.00	41.75	48.25	54.00	63.00	70.00	76.75	84.00	91.00	105.00	119.00	132.50	147.0
	†	0.18	0.56	1.46	2.50	3.64	4.80	6.41	7.90	9.50	11.23	13.00	16.90	21.00	25.34	30.0
3/8	*	21.95	34.60	49.00	60.00	69.00	77.00	90.00	100.00	110.50	121.00	130.00	151.00	171.00	191.00	211.0
	†	0.24	0.81	2.11	3.62	5.20	6.90	9.14	11.30	13.65	16.20	18.60	24.30	30.00	36.50	43.2
1/2	*	39.00	61.60	87.00	107.00	123.00	138.00	161.00	179.00	196.40	215.00	232.00	268.00	304.00	340.00	376.0
	†	0.43	1.44	3.75	6.45	9.26	12.24	16.30	20.16	24.24	28.70	33.10	43.10	54.00	65.00	77.0
5/8	*	61.00	96.50	136.00	167.00	193.00	216.00	252.00	280.00	307.00	336.00	364.00	420.00	476.00	532.00	587.0
	†	0.68	2.27	5.87	10.00	14.54	19.20	25.61	31.70	37.90	44.90	52.00	68.10	84.00	101.70	120.0
3/4	*	87.60	133.00	196.00	240.00	277.00	310.00	362.00	400.00	441.80	482.00	522.00	604.00	685.00	765.00	843.0
	†	0.97	3.13	8.46	14.50	21.00	27.60	36.70	45.20	34.60	64.40	74.70	97.20	121.00	146.40	173.0
7/8	*	119.50	182.00	267.00	326.00	378.00	422.00	493.00	550.00	601.30	658.00	710.00	823.00	930.00	1,004.00	1,145.0
	†	1.33	4.44	11.53	19.67	28.50	37.60	50.00	62.10	75.50	89.00	101.40	132.00	164.00	192.00	234.0
1	*	156.00	247.00	350.00	427.00	494.00	550.00	645.00	715.00	785.40	860.00	930.00	1,070.00	1,215.00	1,360.00	1,500.0
	†	1.74	5.81	15.10	25.80	37.20	50.00	65.50	80.80	102.00	115.00	132.80	172.00	215.00	260.00	308.0

sor of about double this quantity. The additional quantity will be very quickly utilized in your work and the first cost will not be unreasonably greater. You will not regret doing this. You cannot get the air receiver too large.

For large nozzles, 3/8-inch, 1/2-inch, 5/8-inch or 3/4-inch diameter of bore, the air pressures of 20 to 40 pounds, use 1 1/2-inch hose at least. For pressures 45 to 80 pounds use 3/4-inch delivery hose and 1/4-inch nozzle. This size hose is easier to handle, does not fatigue the operator as much as a larger size and the highest velocity of the mixed air and sand is maintained. Do not kink or bend the hose to shut off the sand. It destroys the hose very quickly fills the tube with solid sand, which, with the power required to eject it, is wasted as far as working effect is concerned. If this were not the case, every sand blast would be provided with a shut-off valve at the nozzle end of the hose.

NOZZLES.

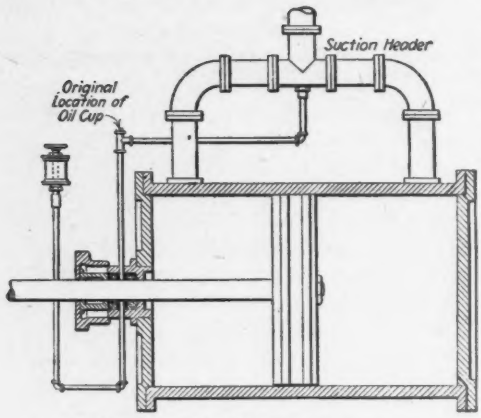
All nozzles will wear, some faster than others, and no nozzle has yet been made that will stand up to this severe work for any length of time. The material of which a nozzle is made makes very little difference in the rapidity of its wear. All wear too quickly. A short nozzle wears better usually than a long one in which the sand eddies from side to side, expending valuable energy in wearing out the containing tube.

As the nozzle wears, the consumption of air increases very rapidly, for which reason it is not good economy to continue to use a nozzle that is worn much beyond the original bore. Valuable power is easily wasted in this manner and a compressor closely calculated for given work may easily become overworked. Change the nozzle when its outlet becomes appreciably greater than the original bore and save the air. A cylindrical nozzle never wears at the point of entrance but always at the outlet end. A disc nozzle, on the contrary, wears on the inlet side and not at the outlet, hence the volume of air consumed always remains constant and the pressure steady.

Make the cleaning room as simple and as light as possible. Admit light from above when possible. Make the floor of steel sheets to retain the sand and have all walls tight and protected from the flying sand.

Make the dust outlet near the floor, in the wall opposite the door and connect to it an ample exhaust fan. The dust will then be drawn down and away from the worker's face and the fan suction may be increased to a point at which the dust is always kept away from him. Admit fresh air through door. Locate the cleaning room so that the castings may come to it in regular order. Save steps and time.

Put the sand blast in charge of an intelligent workman who understands the machine and elevate the work from a "job" to a department, giving due credit for prompt, quick and clean work. The sand blast is as important and useful a tool in the shop as a lathe, drill, planer, grinder or other machine tool and will save its cost when properly located and handled. The sand blast requires dry air under proper pressure and dry sand to give satisfactory results. The sand must flow from the sand tank. You cannot ram it through.—*The Foundry.*



SHOWING CHANGE IN OIL PIPE.

LUBRICATING COMPRESSOR PISTON ROD

The stuffing-boxes on two ice machines in a small refrigerating plant gave considerable trouble. Unless three or four times as much oil as is usually needed was supplied, the rods would either run hot or leak and the packing would soon wear out. It was difficult to keep engineers for a time after the plant was started and most of them kept out of trouble with the ammonia rods by using excessive quantities of oil.

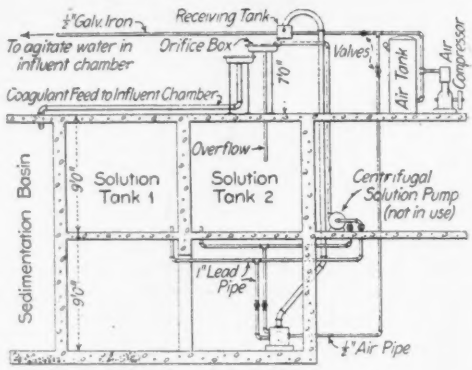
Finally, a man came along that stuck to the job. As soon as he was settled he turned his attention to the ammonia rods. The oil-cup connections to the stuffing-boxes struck him as peculiar and not according to the best practice, so he decided to change them.

The sketch shows the oil cup in the changed position and also shows its original location. The machines were of the horizontal double-acting type. In this machine there is usually more or less gas escaping through the connection to the suction line. With the original connection the escaping gas carried much of the oil along with it into the suction line and into the system; in fact, the system was loaded with oil, as was found later. Connecting the oil cups to the under side of the stuffing-box overcame this defect and thereafter a small amount of oil was needed.—Thomas G. Thurston, in *Power*.

AN AIR LIFT ELIMINATES CORROSION

By utilizing the airlift principle to pump coagulant solution in the filtration plant at Ottumwa, Iowa, H. A. Brown, superintendent, has eliminated pump corrosion difficulties. Originally the plant was equipped with small centrifugal pumps made of "acid-proof" bronze. They were serviceable only a little more than two years, being so badly eaten away by that time as to render them useless.

To solve the annoying problem the superintendent conceived the idea of using an air-lift and installed an experimental pump consisting of a 1¼-in. pipe placed in the solution tank and discharging into a receiving tank over the orifice box. The bottom end of the 1¼-in. pipe was split for about 6 in. to receive the upturned end of a ½-in. air pipe. This crude form of an air-lift worked satisfactorily until the solution in the tank was one-third used up. Due to an insufficient submergence, the remainder of the liquid could not be discharged.



AIR LIFT IN FILTERATION PLANT.

A permanent installation was made by connecting a 12 x 12 x 8-in. lead box, located 9 ft. below the bottom of the solution tanks, with a 1¼-in. lead pipe discharging into the receiving tank. A ½-in. lead air pipe was brought into the side of the box and directed into the 1¼-in. pipe. The solution tank is 9 ft. deep and the receiving tank is 7 ft. above the solution tank thus giving a submergence of from 36 to .72 per cent. of the total lift. Under this condition the pump works successfully and the full capacity of the solution tank can be utilized. Air under 5 lb. pressure is employed.

Decorated glass is made by painting the surface with easily fusible glazes. After drying the glass is put in a kiln and heated sufficiently to fuse the glaze.

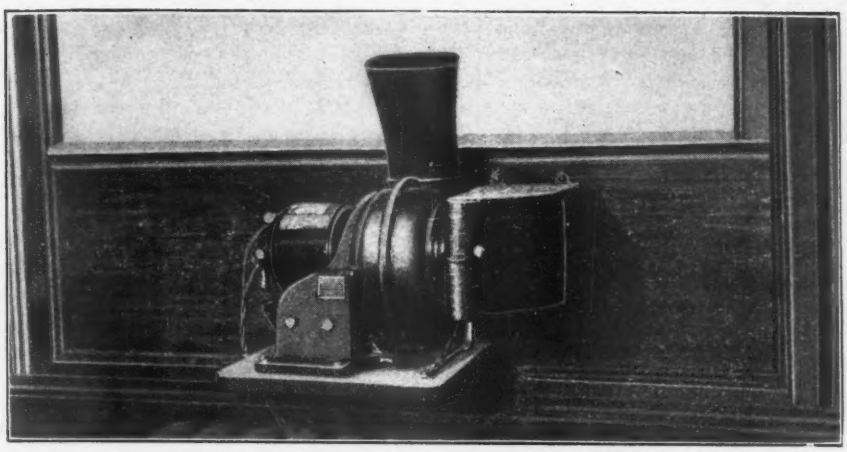


FIG. 1.

FRESH AIR VENTILATION WITHOUT DRAFTS

The Chicago Ventilation Commission some years ago came to the conclusion that ventilation with cold outdoor air was impractical, owing to the tendency of very cold air to resist diffusion with the warmer air of the room. The air warmed by the radiators went to the ceiling while the cold air fell to the floor. The Gerdes ventilator, manufactured by Gerdes & Company, 30 Church street, New York, overcomes this difficulty in two ways: by blowing the cold air to the ceiling with sufficient velocity to cause it to creep along the ceiling until it fals away in all parts of the room, and, when the weather is very cold out of doors (below 25 degrees F), by mechanically mixing enough warm air from the room with the cold air to bring the temperature of the mixture to a normal coolness (about 30 degrees F). The result is that a uniform temperature exists from floor to ceiling and absolutely no draughts are felt, in fact, it is impossible to feel that cold air is coming into the room.

The ventilator consists of a Westinghouse Sirocco blower together with a combined duct and mixing chamber for bringing outdoor air or indoor air to the blower, or a mixture of the two sufficient to maintain a comfortable atmosphere in the room. When the slide in the duct is brought forward and the duct closed to the room, as shown in Fig. 1, the blower draws only cold outdoor air, when it is pushed back the cold air is cut off and air from the room is recirculated; when the duct is partly open to the room, as shown in Fig. 2, the slide closes the opening to outdoors by the same amount and streams of cold outdoor air and warm indoor air mix in the blower. By adjusting the slide any temperature can be had at the nozzle between that existing indoors and out. The cool mixture, being blown to the ceiling, spreads out against it, and, after losing its momentum, gradually sinks through the warm room air and is breathed before it passes to the radiators.

The outfit is operated by current from the lighting circuit. It requires about the same current as an ordinary incandescent bulb and

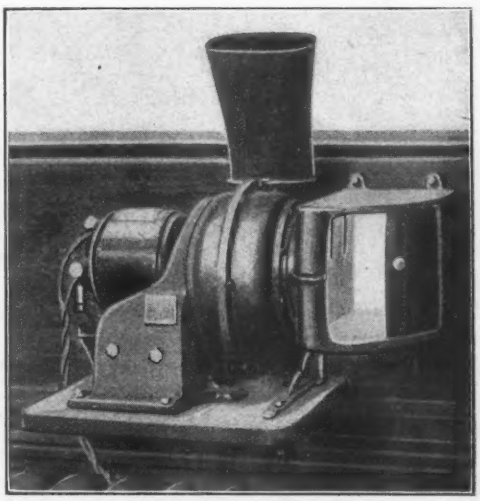
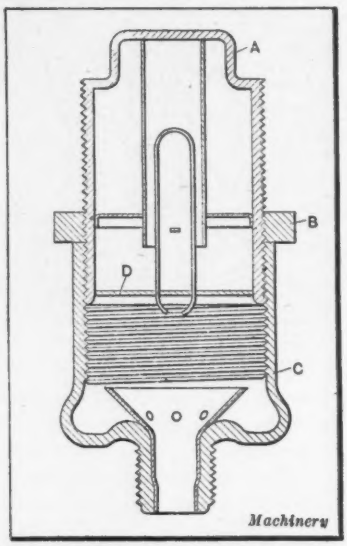


FIG. 2.

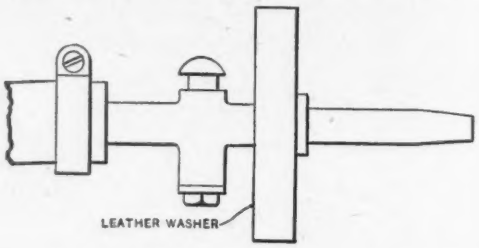
no special wiring is necessary. It can be installed or removed in a few minutes and the placing of the window board in the window frame causes no damage to the woodwork.



A COMPRESSED AIR GREASE CUP

The cut here reproduced from *Machinery* shows the essential features of a new grease cup described in *Engineering*, London. It is entirely self contained and is not dependent for its operation upon an air compressor or any outside supply of compressed air, the air pressure being secured by the screwing down of the inverted cup which forms the cap.

The lubricator, as will be seen from the illustration, consists of three main parts: a cup *C*, a cover or top *A*, and a lock-nut *B*. Parts *A* and *C* are pressed out of mild steel or brass. The top *A* contains a suspended disk *D*, the object of which is to keep the upper surface of the grease flat, and prevent the air from forcing a passage through the grease. When the cup is filled with grease, this should be packed down so as to prevent large air cavities in it. The suspended disk is pulled out to the end of top *A*, and the latter is screwed into the cup about ¼ or ⅜ inch, this being sufficient to compress the air the required amount, as all parts are hermetically sealed by the grease. The lock-nut is then tightened by hand. The small funnel at the bottom of the cup is made of thin sheet steel so that if the bearing becomes heated, the heat is quickly transferred to the grease, which melts and runs down. The heating of the grease also heats the confined air and increases its pressure when the pressure is needed. The cup *A* must be screwed down occasionally as the supply of grease decreases.



SAFETY COLLAR TO PROTECT AIR VALVES

In a manufacturing plant making extensive use of compressed air self-closing valves with which all hose ends were equipped frequently gave trouble due to leakage and breakage. A study of the conditions under which the valves were used revealed the fact that when the workers were through using the air they would drop the hose onto the floor near their work so that it would be convenient when needed. As the floors are of cement the valve received a hard blow many times a day. It seemed to be impossible to break the men of this habit of rough handling, partly because the noise of the machinery made it impossible for them to realize what a severe blow the valve really received, and also because the piece work system does not encourage workers to expend any thought on matters that do not immediately increase the "upholstering" of their pay envelopes. The whole trouble was eliminated by the addition of a safety collar as shown. This collar is simply a leather washer about three inches in diameter, built up to a thickness of half an inch and provided with a hole of the proper size to permit it to be slipped onto the nozzle of the valve just in front of the push button. This collar is held securely in place by the addition of a metal band soldered to the nozzle, and the arrangement leaves the valve easy of manipulation and does not prevent getting the air just where it is needed.—*Machinery.*

Analysis of subway dust in New York gave the following contents: metallic iron, 46%; iron oxide, 14.5%; lime and plaster, 12.1%; grease, 1.12%; and water and organic matter, 12.6%.

CHOOSING ROCK DRILL EQUIPMENT

BY P. B. MC DONALD.

Most mines possess rock-drills of several different makes, and some have a motley collection of drills perhaps none too well suited for the work in hand, usually purchased at various times without due regard for any standardization. Thus it is necessary to keep on hand repair-parts, from a half-dozen different drill manufacturers, that have a habit of getting mixed together on the warehouse shelves. A single mine may be driving with Sullivan and Ingersoll-Rand reciprocating drills, stoping with Cleveland, McKiernan-Terry, and Murphy hammer-drills, and sinking with some other make of plugger-drill; while there may be another variety or two of drill lying around the place, either going to rust underground or reposing in idleness in the corner of the warehouse, not used because some one cannot find a certain repair-part, or because a foreman has a prejudice against the type.

There is an excuse, of course, for getting the matter of rock-drills somewhat mixed, because there have been so many innovations in the design and construction of such machines in the past year or two that fashions in drills have changed almost as rapidly as in clothes. Newer and more efficient types of drills have constantly succeeded each other. The general tendency has been toward utilizing the hammer principle; first for up holes, as in overhead stoping; and then for down-holes, as in shaft-sinking by pluggers; and even for more or less flat holes in driving, as with the Leyner or new Sullivan mounted hammer-drill. Lighter, faster, and more automatic drills have also been sought. The heavy columns and bars for mounting drills have been replaced by lighter ones, which do not break a man's back to set up, or by none at all, as in the case of the stopers and sinkers. The future may see driving regularly accomplished by drills hung on a short rope or even held in the hands!

In picking out rock-drill equipment for a new mine, it is well to consider carefully a number of the newest models, and then to standardize on a type or types suitable for three essentials of mining: sinking, driving, and stoping. It is, of course, necessary to know what kind of rock is to be broken. A mounted hammer-drill, such as the Leyner or new Sullivan, may be the best for a hard brittle rock, where clogging by mud in the bottom of the hole is not likely, and where the water principle through hollow steel is useful for dust prevention. For soft sticky rock such as slate, an old-fashioned reciprocating slugger type for pounding out results may give the best satisfaction in the end; in extreme cases even the declining tappet-valve drills may make up in sureness what they lack in speed. However, one or two of the newer light mounted drills can handle a wide range of rock; such as the butterfly-valve one-man machine that so startled operators a year or two ago. An auxiliary-valve drill is also capable of wide use, since such a valve assures both quickness and certainty by its combination of the spool principle with the auxiliary tappet or ball.

The foregoing refers only to mounted rock-drills, such as were used for all purposes around a mine until recently. Today mounted drills have their greatest field in driving, since stopers have superseded them for rising and overhand stoping, and pluggers for sinking. But they are yet an all-around drill, and in a small mine can be used to advantage for any purpose. On the other hand, I have seen several small mines that did all their work with a jack-hammer or two, making it do for all varieties of holes; while a stoper or ordinary hammer-drill can be utilized to do surprising things, as shown in the enlargement of the Rolling-mill shaft at Negaunee, working from the surface down by angle-holes from below. This is also illustrated by the many shifts to which a hammer-drill is turned in small mines, where it has been used for flat holes and driving. Stoping in some mining districts is still carried on with mounted piston-drills on tripods or bars, especially where the ore seam is at a flat angle, as at Birmingham, or where underhand stoping is performed in long 'rooms.' On the whole, however, no one doubts that hammer-drills have revolutionized stoping, as to a smaller extent plugger-drills of the jack-hammer type have revolutionized shaft-sinking.

An additional factor to consider in choosing rock drill equipment is the type of labor that is available to operate and repair the drills. In some districts, it is impossible to get intelligent men, so that a drill requiring brains and

judgment to make it go cannot be employed even though it is a whirlwind at drilling when it operates. For a large mine with capable machinists and well equipped shops, specialized and freak drills can be tried, and often marvelous results attained, but for a small mine with none too good labor, a drill should be selected which will stand abuse and poor care, and will run fairly well anyway.

Some drills are finicky. They will drill very fast for a time, and then need nursing and humoring. The Leyner drill was formerly accused of this fault, but since the Ingersoll-Rand Company has been manufacturing it, several improvements have been made that lessen the tendency. And it cannot be denied that in hard rock, with intelligent operators, the water Leyner is, like the old race-horse Maud S., a world-beater. Very likely other mounted hammer-drills will be put in the field, since the Leyner has demonstrated what can be done in that line, utilizing the scientific advantages of the hammer principle over the slugging or reciprocating method of punching hard rock. In fact, the new Sullivan mounted drill is much like the Leyner, being a 145-lb. machine of the hammer type with water attachment.

There are several other points of some importance to be observed in choosing a rock-drill, such as methods of lubrication, short-stroking arrangements, length of feed, and so on. But such details can best be decided by the man on the job to suit his own ideas on the subject, and no general principles are involved beyond common sense.

As to the various hammer or stoper drills of the unmounted air-feed type, I do not think there is so much difference. There are a number of good ones on the market. Their valves differ, some have spools, some butterfly, some ball valves, and some no valve at all, but practically all of them will hold a drill-steel fairly close to the face and hammer it "fast and furious."

As with stopers, so with pluggers or sinkers, there are a number of good makes on the market, and it is not so necessary to exercise careful judgment in the selection. It is not meant to imply that some stopers and pluggers have not certain advantages over others of their class, but such advantages (aside from automatic rotation of pluggers) are usually merely mechanical details which appeal to one superintendent and not to another. Thus it is a question of personal conviction, more than a matter of principle, whether a stoper has ordinary or reverse feed, whether it weighs 55 or 100 lbs., whether a plugger rotates by the reciprocating energy of the hammer or by a separate small engine. Such matters can be best decided by the superintendent on the job to suit his own ideas and the details of the situation. It need only be said that the automatically rotating plugger is a surprisingly satisfactory drill for shaft-sinking or down-holes in general. Hollow drill-steel is generally used for blowing out the rock-chippings by air or water. Other things being equal, having selected a stoper or plugger-drill, it is good practice to standardize the type for its own class of work in order to simplify the repair-parts problem. A large mine will probably require three kinds of rock-drills; mounted drills (either reciprocating or hammer type) of one-man or two-man style, for driving and all-around work (including perhaps stoping); stoper hammer air-feed drills for rising and overhead stoping; pluggers for shaft-sinking and block-holing.—*Mining Press.*

GETTING A LIVING BY SUCTION

A certain fish which is generally known as the remora, or shark-sucker, has modified the gills on the back of his head so that they form a sucker. With this he "hitches on" to the underside of some big predatory fish, generally one of the sharks, and thus, without having to use his own fins and tail at all, he is pulled through the sea, getting a free ride. Whenever the shark finds a school of fish he dashes among them at great speed, snapping his huge jaws in every direction and killing twice as many fish as he can eat. The remora then unhitches himself and dines quietly off the fragments of half-eaten fish that come slowly sinking down through the water. It takes less to fill him up than it does the shark, so his hunger is usually the first to be satisfied. When he has dined, lunched or breakfasted, as the case may be, the remora swims below the shark again, and after his free meal gets ready for more free transportation.

The rivers of the United States carry yearly to tidewater 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter. This total of 783,000,000 tons represents 350,000,000 cu. yd. of rock, or 610,000,000 of surface soil.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - - Editor
FRANK RICHARDS, - - Managing Editor
CHAS. A. HIRSCHBERG, - Business Manager
W. C. LAROS, - - - Circulation Manager

PUBLISHED MONTHLY BY THE

Compressed Air Magazine Company

Easton, Pa.

New York Office—11 Broadway.
London Office—165 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XX. JUNE, 1915. No. 6

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FIRST AWARDS OF THE FRANKLIN MEDAL

The Franklin Medal, the highest recognition in the gift of the Franklin Institute of the State of Pennsylvania, has recently been awarded to Heike Kamerlingh Onnes and to Thomas Alva Edison

The fund from which this medal is awarded was founded Jan. 1, 1914, by Samuel Insull. Awards of the medal are to be made annually to those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the Institute, have done most to advance the knowledge of physical science or its applications, the present awards being the first that have been made.

The medal awarded to Prof. Onnes was received on his behalf by His Excellency, Chevalier van Rappard, Minister from the Royal Netherlands Government, at the stated meeting of the Institute on the evening of May 19, and at this meeting Mr. Edison was the guest of the Institute and received his award in person. Following the presentations an address entitled "Electricity and Modern Industrial Growth" was delivered by Mr Insull.

Sketches of the lives of the recipients of the medal, and also of Mr. Insull, the donor are appended:

THOMAS ALVA EDISON.

Thomas Alva Edison was born at Milan, Ohio, February 11, 1847. In 1854 he went with his parents to Port Huron, Mich. His early education was received from his mother.

Very soon his fondness for chemistry became apparent, and at the age of twelve, to obtain money for the purchase of chemical apparatus, he became a train boy on the Grand Trunk Railway, operating between Port Huron and Detroit. While working in this capacity he secured a hand press and edited and printed a small paper, *The Weekly Herald,* selling some three hundred copies per week to employees of the road. Train telegraphy was taught him in 1862 by the station agent at Mt. Clemens, Mich., where he later became the operator. The following year he was transferred to Stratford Junction, Canada, but his dislike for routine work led him to become a tramp operator, and for the next five years he moved from one to another station in the middle West.

In 1864, while in Indianapolis, he invented an automatic telegraph repeater. This was

probably the first of his long series of inventions.

In 1868 he moved to Boston, where he obtained a position with the Western Union Telegraph Company. While here he invented a vote-recording machine, for which he obtained his first patent, in 1869. There was no demand, however, for such a machine at the time, and it was not developed to a commercial success.

Soon after this he invented a stock ticker, and started a ticker service in Boston, with about forty subscribers. At this time he also experimented with a duplex telegraph, but this not being at first successful he devoted himself to the commercial development of his stock ticker, which was later sold to New York capitalists for $40,000. His work in this connection brought him into association with the late Franklin L, Pope, with whom he entered into partnership in 1869. J. N. Ashley later also became a partner, and the firm secured a large amount of business. With the money Edison received for his improved ticker he established a factory at Newark, N. J. for building these machines in large quantities.

Experimenting again with the automatic telegraph he developed it to a point where he was able to send three thousand words per minute between New York and Philadelphia and record them in Roman type. An arrangement was then made with the British postal telegraph authorities to demonstrate the automatic system in England, and Edison went over in 1873 to make the demonstration.

In 1873 Bell invented the telephone, but something more powerful than the magneto transmitter, or something capable of amplifying without distortion extremely small telephonic currents, was necessary, among other things, for its commercial success. In 1875 Edison devised his carbon transmitter, now almost universally used.

In 1878 he invented his tinfoil phonograph, creating world-wide interest, and a number were constructed for exhibition purposes. This machine was succeeded by his wax-cylinder machine, in 1888, which later developed into a device of great commercial value.

His contributions to the art of electric lighting have been fundamental. In 1876 he moved to Menlo Park, N. J., where for ten years he was engaged on his incandescent lamp, dynamo, and system of low-pressure electrical distribution. The Pearl Street Station in New York City, started on September 4, 1882, the first successful electric station in America, will ever remain a monument to Mr. Edison's skill and tireless energy. By the end of December of the same year this station was supplying current to over five thousand incandescent lamps.

Electrical problems easily solved to-day were by no means easy of solution thirty-odd years ago, and it is doubtful if more than a very few electrical engineers of the present generation are conscious of the debt they owe to the great electrical pioneers of the '70's and '80's.

Motion-picture apparatus and alkaline storage batteries are among many other inventions produced by Mr. Edison as a result of incessant effort and great concentration.

That he has lost none of his youthful energy or determination in the matter of overcoming difficulties is seen by the rapidity with which he reconstructed his enormous factories at Orange, N. J., destroyed only on December 9, 1914, by fire.

HEIKE KAMERLINGH ONNES.

Heike Kamerlingh Onnes was born on September 21, 1853, at Groningen, Holland, where his father was engaged in manufacture. He was educated in the schools of his native town, and there also he began his university studies in 1870. Two years later he removed to Heidelberg, where he spent three semesters, working under the direction of Bunsen and Kirchoff. He then returned to Groningen, and a few years after he became assistant to Professor Bosscha at Delft, where he commenced work upon his thesis for doctorate. In 1882 he and H. A. Lorentz were appointed professors of physics in the University of Leiden, then a little known and quite unpretentious seat of learning (so far as physical science was concerned), but which, as a result of the collaboration of these two highly-gifted and energetic young physicists, has become one of the world's great centres of physical research.

While Lorentz confined his energies mostly to the fields of theoretical and mathematical physics, Onnes directed his energies to the creation of a laboratory for experimental research. In spite of great obstacles, particularly of very inadequate appropriations for equipment and maintenance, the indefatigable di-

rector found ways and means of furnishing his laboratory with the special machinery and precision instruments required for the researches of the professors and their students. A very important—in fact, an essential—factor in this development was the establishment by Onnes of a training school for mechanicians, and it was in the shops of this school that many of the special instruments for the laboratory were constructed. At the same time the young men engaged there were trained to assist the director in carrying out the often difficult and intricate operations in his experimental work. On various occasions Professor Onnes was thus enabled to command a force of some thirty assistants, to each of whom a special duty was assigned.

The work of this great laboratory at Leyden is recorded in the *Leiden Communications*, published since 1891, and includes a vast number of most important contributions to physical science. Among them are investigations on magneto-electric effects, as well as a series of most important papers upon magneto-optical phenomena, such as the classical one by Zeeman, describing the discovery of what is now known as the Zeeman-effect. But, while these early investigations were all carried out under Onnes' direction, they were in many cases inspired or suggested by his distinguished colleague, H. A. Lorentz.

The really representative work of the laboratory has been in the field of molecular physics, and particularly in research at low temperature. The great bulk of the *Leiden Communications* is devoted to the records of those remarkable series of researches which were conceived by Onnes himself and carried out under his direction. The history of these researches began with the creation of the cryogenic laboratory, and it may be divided into several distinct stages or periods. The first of these was occupied with the production of liquid oxygen on a large scale, and with the use of this material in a three-cycle process of obtaining low temperatures, by which Onnes was enabled to maintain and control the temperature ranges from —23° to —90° (methyl chloride), from —105° to —165° (ethylene), and —183° to —217° (oxygen). This goal may be said to have been attained about 1894. The second stage was characterized by the introduction of liquid hydrogen and the production of temperatures below —217°. The abnormal behavior of hydrogen gas when it is allowed to expand under reduced pressures made it impossible to liquefy it at higher temperatures; and the condensation of this gas was first achieved by Dewar, of London, on May 10, 1898. This added a new range of available low temperatures from —253° to —250° in which Dewar made a number of highly remarkable observations, including the solidifications of hydrogen. But Onnes very promptly appropriated this new range for his research work, and constructed novel and very efficient apparatus for the production and utilization of the new refrigerant.

The Netherlands Government, realizing the importance of the work, now granted considerable appropriations for the extension and equipment of the laboratory, and with its completion a new era of constantly increasing low temperature research began. New methods and instruments for the exact measurement of temperatures below the boiling-point of liquid hydrogen were devised, and the behavior of mixtures of hydrogen and helium was systematically investigated. Finally, the apparently incoercible gas, helium, was reduced to the liquid state. This crowning triumph of low temperature research was achieved on July 10, 1908. While this supreme achievement aroused universal interest in the work of Onnes and doubtless prompted the award to him, in 1913, of the Nobel Prize in Physics, it was by no means (as many seem to suppose) a *tour de force*, but only the culmination of the long-continued and unremitting life-work of a great investigator.

During the past few years Onnes has made some most remarkable discoveries with reference to the electrical resistance of certain metals at temperatures only a few degrees above the absolute zero of temperature. The resistance of metals ordinarily varies approximately with the absolute temperature, but at temperatures only a few degrees above the absolute zero it suddenly becomes so small that it can hardly be measured. For mercury this "critical temperature" is 4.2° absolute; for lead it is 6.1°; and for tin 3.8°. Below these temperatures the resistance is practically *nil*, and Onnes terms this the "supraconductive" state. In this state the metals no longer obey Ohm's Law—there is neither a potential drop nor a production of heat. Onnes has shown that, in a lead coil cooled to 1.7° abso-

lute, a current of 0.4 ampères induced in the coil by the removal of an electromagnet whose flux had previously passed through it continued to flow without appreciable diminution for more than two hours. This result is bound to exert a profound influence upon our views of electrical conduction and molecular magnets, and perhaps the use of supraconductors may some time afford much stronger magnetic fields than are now available.

SAMUEL INSULL.

Samuel Insull was born at London, England, in 1859, and was educated in private schools in that city, at Reading and Oxford. He came to the United States in 1881 and became private secretary to Thomas A. Edison, of whose business affairs he had full charge for many years. He represented Edison in the organization and management of the Edison Machine Company, the Edison Lamp Company, and others of his early corporations. In 1889, upon the consolidation of the various Edison concerns into the Edison General Electric Company, he was appointed second vice-president of the corporation and assumed charge of its manufacturing and selling departments. Three years later the General Electric Company was formed by consolidating with the Thomson-Houston Company, and he continued in the same capacity with the new concern. He resigned a few months later to organize and become president of the Commonwealth Electric Company of Chicago. Since 1907 he has been president of the consolidation of this company with the Chicago Edison Company—The Commonwealth Edison Company, which controls the electric lighting service of the City of Chicago —and he is also an executive of a number of other public service companies. Mr. Insull is a member of the American Institute of Electrical Engineers and the British Institution of Electrical Engineers.

The extraction of gasoline from casing-head gas (natural gas from oil wells) has become one of the important adjuncts of the natural-gas industry in the United States. The production is increasing rapidly, the quantity produced in 1913 having almost doubled that of 1912. It is principally used for raising the standard of naphthas or low-grade distillates consumed in motors; it is also used for lighting; and it can be used like regular gasoline in all the arts.

NEW BOOKS

Centrifugal Pumps. By R. L. Dougherty, Assistant Professor of Hydraulics, Sibley College, Cornell University. McGraw-Hill Book Company, New York, 1915. Cloth, 6 by 9 in. 202 pages, 111 illustrations. $2.00 net.

The rapidly increasing use of centrifugal pumps, thanks largely to the direct electric drive, gives this book a special timeliness. The writer is familiar with his subject and has done his work thoroughly. The various types of pumps are described and illustrated, the theory of operation is lucidly investigated and the practical employment of the pump under various conditions is gone into thoroughly, giving costs, power required, efficiencies, etc. The different chapters are supplemented by problems the solution of which should guarantee a thorough understanding of the subject.

USE OF EXPLOSIVES IN METAL MINES AND QUARRIES

The United States Bureau of Mines, several years ago, issued a primer on explosives for coal miners which has been in considerable demand ever since. Now the bureau has issued a primer on explosives for metal miners and quarrymen, by Charles E. Munroe and Clarence Hall. The bulletin, which has just come from the printing office, says in its instroduction: "In accidents resulting from the use of explosives in metal mines and quarries in the United States more than 130 men were killed and 250 seriously injured during the calendar year 1913. Moreover, an unknown number of miners suffered from the effects of breathing the harmful fumes and gases given off by the burning or the incomplete explosion of some explosive. Consequently, the Federal Bureau of Mines, which is endeavoring to increase safety in mines and to abolish conditions that tend to impair the health of miners, is studying the kinds of explosives used in mining and the conditions under which these explosives can be used with least danger to the miner.

"Inflammable gas or dust is seldom, if ever, found in quarries or metal mines, and the danger from using explosives there is less than in coal mines; but, as the figures show, the number of men killed and injured yearly in accidents caused by explosives proves the need of both miners and mine officials striving to see that none but proper explosives are used and that these are used properly."

The bulletin contains chapters on combustion and explosion; blasting and mine explosives; fuse, detonators, and electric detonators; firing blasts by electricity; the use of explosives in excavation work; the use of explosives in quarrying; the use of explosives in metal mining and tunneling; drilling and blasting methods on New York rapid-transit tunnel; magazines and thaw houses; permissible explosives, etc.

This publication is Bulletin 80, and it may be obtained free of charge by those interested writing to the Director of the Bureau of Mines, Washington, D. C.

HONORS TO THE INVENTORS OF THE HUMPHREY PUMP AND THE ESCALATOR

The City of Philadelphia, acting on the recommendation of The Franklin Institute, has awarded the John Scott Legacy Medal and Premium to Herbert Alfred Humphrey, of London, England, and to Cav. Ing. Alberto Cerasoli, of Rome, Italy, for the Humphrey Pump, a device for raising water by the direct application of the explosive energy of a mixture of combustible gas and air. The first installation of a Humphrey Pump was made at Dudley Port, in England, in 1909. Three years later, four pumps, each having a capacity of 40,000,000 gallons per day, and one pump of 20,000,000 gallons per day, were installed by the London Metropolitan Water Board. Tests subsequently made on these pumps gave an average fuel consumption of 0.904 pound anthracite coal per pump horse power hour.

The Edward Longstreth Medal of Merit has been awarded to the late Mr. George A. Wheeler for his Escalator. This invention is an inclined elevator for transporting persons from one level to another. It consists of an endless system of stairs or steps having risers and treads, together with top and bottom landings.

ANNUAL MEETING OF ADVERTISING CLUBS

Chicago will be the scene of the eleventh annual convention of the Associated Advertising Clubs of the World which meets June 20 to 24. This great gathering of the dynamos of the business world to discuss common problems and to advance the banner of truth in advertising promises to hold a unique place in the events of the year. On the Sunday preceding the formal opening of the convention, fifty business men of country wide reputation will deliver lay sermons in Chicago churches.

New features include a conference of the teachers of advertising and another of the secretaries of advertising clubs. Departmental meetings of men in the several fields of work give opportunity for a discussion of the problems of various phases of advertising, an arrangement which reflects the new freedom in business.

Amusements include a list of social functions for the ladies, a Gridiron Show to be staged by one hundred and fifty Chicago men, lake and automobile trips. A whirlwind campaign is being waged by advertising clubs in an effort to mobilize in Chicago at full war strength.

NOTES

It is expected that the new steel plant of the International High Speed Steel Company at Rockaway, N. J., will be in full operation at the end of the present month. The product will be confined to the company's highest grades of tool steels, alloy steels and high speed steels of all shapes and sizes, rock drill steels, solid octagon and cruciform, hollow hexagon and round, not heretofore made in the United States.

Repair cost of storage-battery locomotives at the Bunker Hill & Sullivan mines runs from $0.00359 to $0.01189 per ton hauled. Trolley locomotives cost from $0.00435 to $0.00641 per ton. In the first instance the highest expense was up to $55.456 per month, and with the other machines $93.912 per month.

The number of deaths of aviators in the war service is very much smaller than the death records in time of peace, one of the explanations being that aerial navigation is quite safe when there is no indulgence in exhibition stunts that have brought so many disasters. When an aeroplane is handled by a skillful aviator for the legitimate purpose of plain flying, it is a very much safer means of transportation than is generally believed.

The gas company at Nashville recently demolished an old holder which was 110 ft. in diameter by means of the oxy-acetylene torch. They made 26 vertical cuts around the circumference and as each slice was cut off it

was hoisted out of the tank. The metal was 3-16 inch thick with ¾-inch angles and ½-inch thick channels. This work was done by one man in a week, showing the wonderful effectiveness of this little apparatus for big work. In fact the use of this torch for wrecking metal structures has extended itself as a regular equipmnt for some fire departments, where its use has been found of value in saving life and property.

A 26-part tackle with 7,000-ft. hoist lines forms the main fall rigging of the erection traveler used on the Hell Gate arch bridge. A few pieces of 175 tons erection weight and a number weighing over 100 tons have to be handled, those of the east half being already placed. The tackle consists of two 13-sheave blocks. The great length of line is needed to enable the traveler to hoist direct from the river. The boom-fall rigging has 36 parts of wire rope rigged tandem, and is really two separate tackles side by side and connected to an equalizer. Each top block has six main sheaves and four smaller ones. Each bottom block has five main sheaves and five smaller ones. The two ends of each tackle lead to drums, so that there are four lead-lines, going to two drums each with a partition in the middle.

The importance which gas is assuming in the world's activities was again exemplified when the German artillery projected bombs into the camps and trenches of the Allies, these bombs on exploding liberating asphyxiating gases which spread a choking blanket two miles wide over the enemy and caused them to "get out of there" pretty quickly. As a means of carrying on war it is bloodless but none the less effective. Some day we will be fighting fires with such gases in the regular equipment, mobs will be dispelled by pungent or non-breathable gases, we will have gas-pistols as well as gas bombs and something will be found to put into city gas to make suicide by its means a very unpleasant process. We are progressing.—*Gas Age.*

Zinc instead of mortar was used for joining the stones of two elliptical arches of 82 ft. span that support a newly completed reinforced concrete bridge near Lyons, France. Previous experiments having proved that the molten zinc—at 800 deg.—caused no fractures in dry stones, the zinc was melted and poured between the stones, forming metallic joints ⅛ in. thick. This substitution for mortar increased the cost about $2.40 for each sq. ft. of the bridge's horizontal surface. Tests with cubical stones, 2½ in. on a side, showed that zinc joints do not weaken stones having a strength of about 14,000 pounds per sq. in., but are weaker than stones having a strength between 14,000 and 18,500 pounds. A less compressible metal is needed for very hard stones. Cement joints, when as thick as 1-25 in., or less, stood the tests equally well, but disintegration gradually reduces the original strength of joints of mortar.

Du Pont Magazine states that one ingenious contractor placed "the dynamite to be thawed on shelves around the sides of a small building about 10 ft. square with double walls, in the middle of which was an oil stove. A thermometer was placed at a convenient point in the room and a man was instructed to stay in the thaw-house continually while the oil stove was burning to watch the thermometer and turn down the wick when the temperature rose above 80° F. To insure the faithful performances of his duties he was *locked in the room* by the foreman of the blasting gang, and had, therefore, every incentive to keep the temperature at a safe point, as he had no opportunity to evade his responsibility."

Some idea of the wealth of published material relating to oxyacetylene welding may be obtained from a 34-page pamphlet that has been issued by the New York Public Library. This contains a list of works on this subject that may be found in the library, and includes books, articles from periodicals, pamphlets and other literature that is readily accessible. The arrangement is chronological by date of publication from 1893 to October, 1914, and contains a list of 487 books, pamphlets, magazine articles, etc. An index which is arranged by subjects and authors is included. For references to acetylne other than in its relation to welding, readers should consult the various periodicals related to the industry.

The oxy-acetylene welding process has been used successfully for building up flat spots on locomotive driving wheel tires and restoring

them to perfect condition. Instead of removing all the drivers of locomotives and turning them down to the common diameter made necessary by the depth of the flat spots, the flats are filled in with metal welded to the tire, and in a few hours the locomotive is ready for the road. The process saves tires, machining expenses and locomotive time.

In a recent lecture before the Royal Institution Professor Boys showed one of the early flat-flame burners giving a light of 1 candle-power for each cubic foot of gas consumed per hour. Then a more modern burner was shown, giving 2 candle-power. Various types of incandescent burners were next shown, and the lecturer mentioned the results of high-pressure incandescent gas lighting in the London streets, whereby 60 candle-power was obtained per cubic foot.

An interesting feature of the production of granite in California is the quantity of stone quarried from large residual bowlders. These bowlders, according to the United States Geological Survey, represent the remains left from prolonged disintegration of large granite masses, but after a thin weathered coating is removed they yield sound stone.

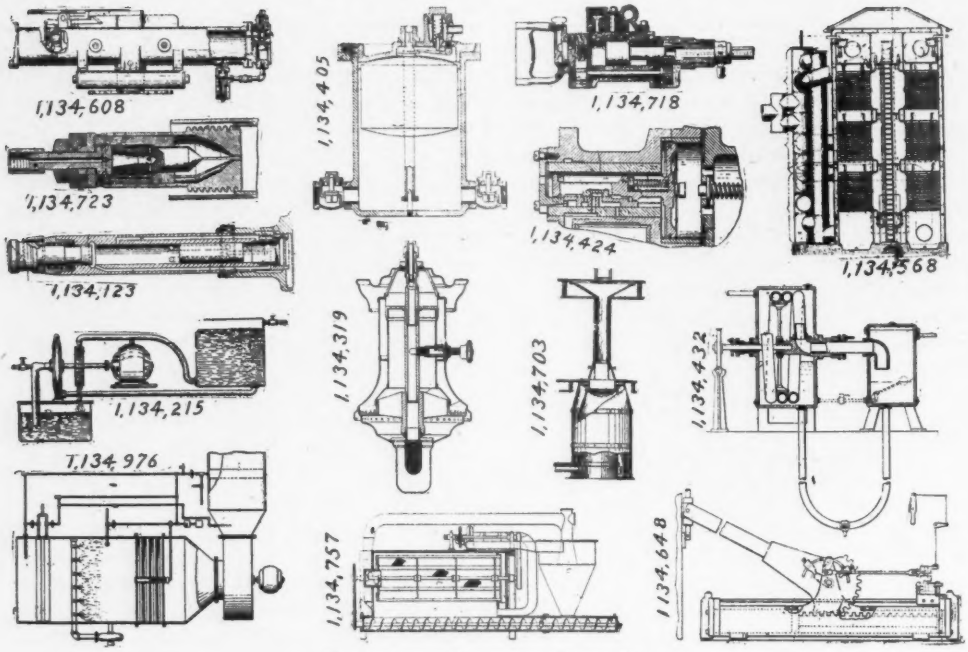
A simple and effective scheme for killing destructive small animals in their burrows has been discovered by Leonardo Ruiz, a rancher, of Ravenna, Calif. About 1½ or 2 in. of a 40 per cent dynamite stick is wrapped in a cloth or paper and provided with a fuse but no detonator. One of these charges is stuck down into each hole and some loose dirt backed around the fuse. There is (or should be) no explosion after lighting the fuse; the dynamite merely burns, filling the hole with dense poisonous fumes. The cost of materials is about 2c per hole.

Every year there averages in the United States between 1300 and 1400 serious boiler accidents, of which 300 to 400 are violent explosions. These accidents kill between 400 and 500 persons, injure 700 to 800 more, and destroy more than half a million dollars' worth of property. In a single explosion, that of the R. B. Grover Shoe Co., at Brockton, Mass., 58 persons were killed, 117 more were injured $250,000 worth of property was destroyed, and an aggregate of $280,000 was claimed in the personal injury and death suits that were brought. In a period of 46 years, since 1867, over 10,000 people have been killed and over 15,000 injured in boiler explosions.

At the plant of the Northwestern Malleable Iron Company, Milwaukee, air for the furnaces was formerly supplied from blowers located at some distance from the furnace which they served, necessitating a considerable length of pipe. For driving these blowers 40 hp. motors were used. Recently individual slow speed blowers have been placed alongside each furnace and 7½ hp. motors, direct connected, have been found of ample size to furnish all the power required.

Fire Commissioner Adamson, of New York, in his report to the mayor says that last year's per capita fire loss was the lowest for any year in the history of the city save one, and the total fire loss the lowest of any year since 1907 save two, although the population is 1,379,000 greater. These results, he says, he has achieved with a budget for 1915 reduced by $65,000 from the budget for 1914, although he has made provision for twenty new fire companies at a cost of $400,000 a year. There has been an increase of 58½ per cent. in the number of orders of the Fire Prevention Bureau which have been obeyed, and an increase of 29½ per cent. in the number issued. He has also established in the courts the right of the fire commissioner to recover the cost of extinguishing a fire which is the result of "culpable and wilful negligence."

The marble columns for the Lincoln Memorial now being erected in Washington are the largest of their kind in the world. Each block weighs about 35 tons as it comes from the quarry, and twelve blocks are required for each 46-ft. column. When completed, one column weighs 192 tons and involves a cost of $15,000. The stone is being shaped at Marble, Colo.; first the blocks are sized with wire saws to the required thickness, then they are passed through the barrel saw, which cuts them into drums. These drums are trued up upon huge lathes, then fluted by carborundum wheels. Finally they are hand finished and each drum fitted perfectly to the one above and below it.



PNEUMATIC PATENTS APRIL 6.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

APRIL 6.

1,134,098. PERFUME - SPRAYER. MAYER JULES ROBERT BLOCH, Paris, France.

1,134,123. FLUID-OPERATED TOOL. LOUIS W. GREVE, Cleveland, Ohio.

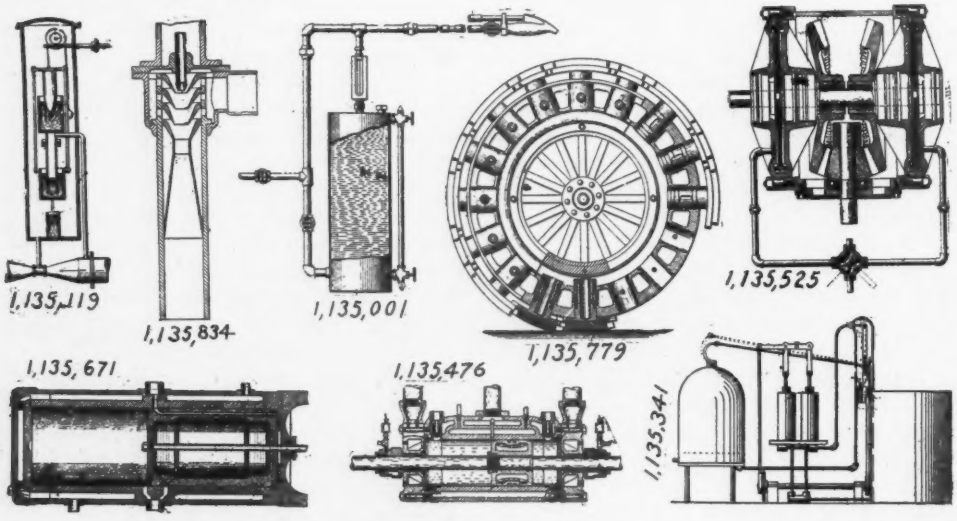
1,134,186. MEANS FOR INFLATING PNEUMATIC TIRES. WILLIAM J. DREW, Racine, Wis.

1,134,215. AIR PUMPING APPARATUS. ROBERT V. MORSE, Ithaca, N. Y.

1,134,294. VACUUM-CLEANER. GEORG SUPANZ, Vienna, Austria-Hungary.

1,134,319. COMPRESSED-GAS LAMP. ERNST DRESLER, Neukolln, Germany.

1,134,402. PNEUMATIC - DESPATCH - TUBE APPARATUS. JOHN T. NEEDHAM, New York, N. Y.



PNEUMATIC PATENTS APRIL 13.

1,134,405. PRESSURE-PUMP AND VACUUM-TRAP. JOHN EDWARD LEWIS OGDEN, Liscard, England.

1,134,424-5. RETARDED RELEASE TRIPLE-VALVE DEVICE. WALTER V. TURNER, Edgewood, Pa.

1,134,426. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,134,432. PROCESS AND APPARATUS FOR COMPRESSING, DRYING, AND TRANSFERRING CHLORIN GAS. JONAS W. AYLSWORTH, East Orange, N. J.

1,134,440. ELECTROPNEUMATIC BRAKE. JOHN W. CLOUD, London, England.

1,135,119. FLUID-METER. JOHN W. LEDOUX, Swarthmore, Pa.

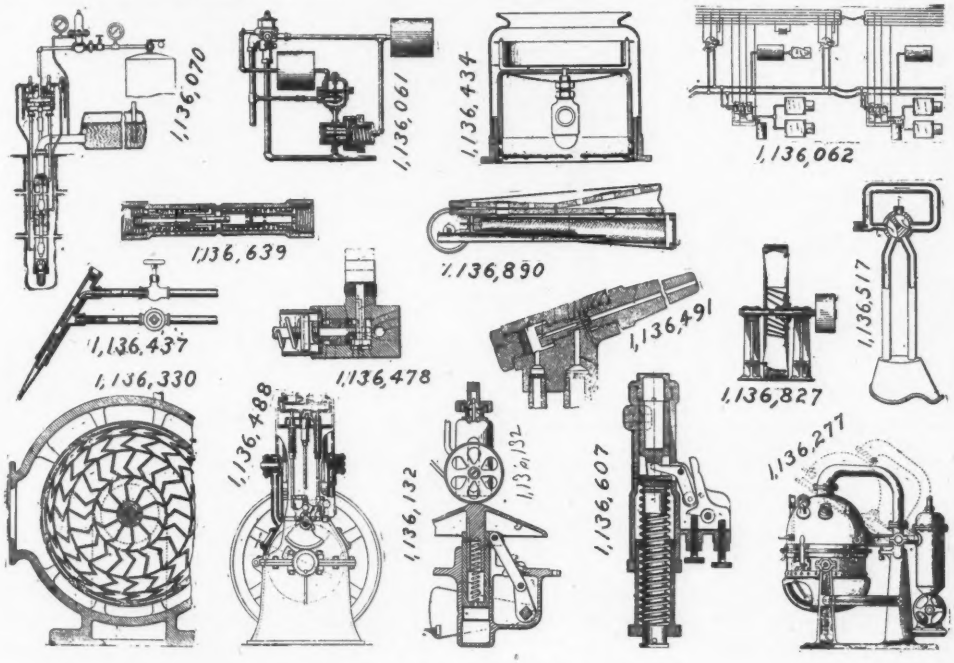
1,135,152. PNEUMATIC AUTOMATIC MUSICAL INSTRUMENT. ROBERT J. BENNETT, Moline, Ill.

1,135,178. FLUID-OPERATED TOOL. LOUIS W. GREVE, Cleveland, Ohio.

1,135,341. TREE-SPRAYER. JAY WILCOX, Rothbury, Mich.

1,135,476. VALVE FOR AIR-COMPRESSORS. ELMER A. WATTS, Springfield, Ohio.

1,135,525. FLUID-ACTUATED CLUTCH. ROBERT L. HIBBARD, Sewickley, Pa.



PNEUMATIC PATENTS APRIL 20.

1,134,568. DRY-BLAST SYSTEM. BRUCE WALTER, Pittsburgh, Pa.

1,134,608. FLUID-PRESSURE DOOR-OPERATING DEVICE. ALBERT GOTTSCHALK, New York, N. Y.

1,134,648. PNEUMATIC OPERATING MECHANISM FOR DOORS, STEPS, OR THE LIKE. GEORGE M. SPENCER, St. Louis, Mo.

1,134,703. HOT-AIR HEATING SYSTEM. JOHN E. SELTZER, Flint, Mich.

1,134,718. PERCUSSIVE TOOL. LEWIS C. BAYLES, Easton, Pa.

1,134,723. PERCUSSIVE BOILER - TUBE CLEANER. WILLIAM BURLINGHAM, Newport News, Va.

1,134,757. APPARATUS FOR AERATING FLOUR. WILLIAM M. NISSLEY, Philadelphia, Pa.

1,134,853. ELECTROPNEUMATIC BRAKE. CLYDE N. HOLCOMBE, New Rochelle, N. Y.;

1,134,976. MEANS FOR HUMIDIFYING AIR. WILLIAM G. R. BRAEMER and SAMUEL C. BLOOM, Camden, N. J.

APRIL 13.

1,135,001. APPARATUS FOR CLEANING SURFACES. GEORGE DURHAM and CHARLES W. MCGUIRK, Scranton, Pa.

1,135,023. COMPRESSED-AIR AND SUCTION WATER-ELEVATOR. WILL L. JONES, Douglas, Ariz.

1,135,610. PNEUMATIC-DESPATCH - TUBE APPARATUS. ALBERT W. PEARSALL and FRED R. TAISEY, Lowell, Mass.

1,135,671. FLUID - COMPRESSOR. ELMER E. DAVIS, West Chicago, Ill.

1,135,779. PNEUMATIC WHEEL. JOSEPH DOVE-SMITH, Niagara Falls, N. Y.

1,135,834. HYDRAULIC AIR-EJECTOR FOR VACUUM CLEANING AND OTHER PURPOSES. CAMPBELL MORTON, Glasgow, Scotland.

1,135,925. PNEUMATIC CUSHION AND SHOCK-ABSORBER. FRED R. F. RICHTER, Niverville, N. Y.

APRIL 20.

1,136,061. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

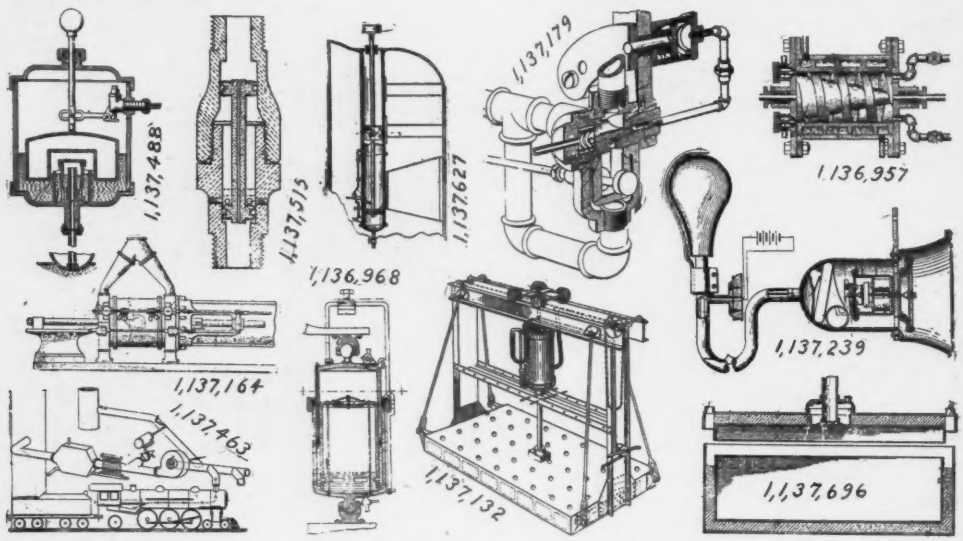
1,136,062. ELECTROPNEUMATIC BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,136,070. PUMPING SYSTEM. FREDERICK C. WEBER, New York, N. Y.

1. In a pumping system, the combination of a source of fluid pressure supply, a liquid chamber having inlet and discharge valves, a reversing valve for admitting fluid pressure from said supply to said chamber, and for exhausting said pressure therefrom, and means for throttling the exhaust from said liquid chamber.

1,136,132. AUTOMATIC TRAIN-STOP DEVICE. ALBERT EDMUND HUDSON, Calgary, Alberta, Canada.

1,136,190. PNEUMATIC MUSICAL INSTRUMENT. PEDER WIGGEN, Chicago, Ill.
1,136,227. OZONATOR. LOUIS GOLDBERG, Indianapolis, Ind.
1,136,277. COOKING VESSEL. PETER H. SCHLUETER, Chicago, Ill.
1. In combination, a bowl shaped kettle, a cover adapted to make sealed engagement with the rim of the kettle, said cover being hingedly supported at one side of the kettle, vacuum creating means connected with the cover and means for heating the kettle.
1,136,330. MULTISTAGE CENTRIFUGAL BLOWER. THOMAS W. GREEN, Philadelphia, Pa.
1,136,372. PNEUMATIC ACTION FOR PLAYER-PIANOS. GEORGE SCHUMANN, Sr., Union Hill, N. J.
1,136,434. PNEUMATIC CARPET-CLEANER. EDWIN E. OVERHOLT, Washington, D. C.
1,136,437. OXYACETYLENE APPARATUS. MICHAEL L. POPP, Milwaukee, Wis.
1,137,132. PNEUMATIC PRESS AND METAL-FORMING MACHINE. EDWARD G. GROSS, Columbus, Ga.
1,137,164. SAFETY DEVICE FOR BLOWING-ENGINES. HENRY G. O'REILLY, Joliet, Ill.
1,137,179. VALVE MECHANISM FOR AIR-BRAKE SYSTEMS. WILLIAM AUSTIN, Scranton, Pa.
1,137,239. COMBINED ELECTRIC AND PNEUMATIC HORN. WILLIAM SPARKS, Jackson, Mich.
1,137,304. GLASS-BLOWING MACHINE. BENJAMIN D. CHAMBERLIN, Washington, D. C.
1,137,327. PNEUMATIC-DESPATCH-TUBE APPARATUS. CHESTER S. JENNINGS, Boston, Mass.
1,137,339. ETCHING APPARATUS. LOUIS E. LEVY and HOWARD S. LEVY, Philadelphia, Pa.
1. In an etching apparatus, a tank for etching fluid, means for effecting an ebullition of the etching fluid by the introduction of air into the etching fluid, means for maintaining a plate to



PNEUMATIC PATENTS APRIL 27.

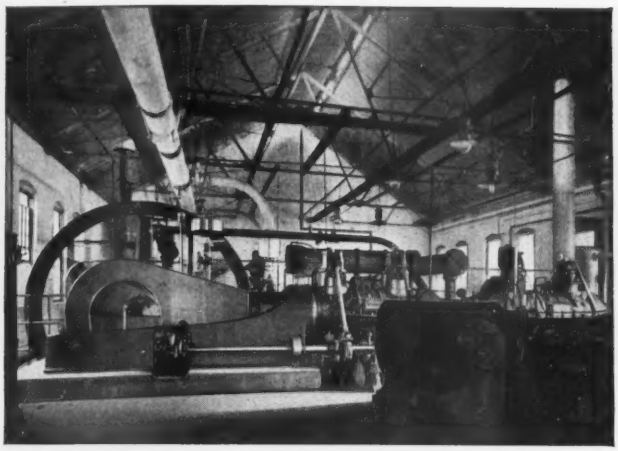
1,136,470. SPRING AIR-GUN. CHARLES F. LEFEVER, Plymouth, Mich.
1,136,478. PRESSURE-TRANSMITTING CONTROLLER. FRANCIS E. MILLS and EDWARD F. MILLS, Boston, Mass.
1,136,491. ACETYLENE BLOWPIPE. ELMER H. SMITH, Minneapolis, Minn.
1,136,517. ARTIFICIAL-BREATHING APPARATUS. JOHANN HEINRICH DRAGER, Lubeck, Germany.
1,136,607. GOVERNOR FOR COMPRESSORS. JOHN L. OSBORNE, Rochester, N. Y.
1,136,619. FLUID PRESSURE OR FLOW REGULATOR OR CONTROLLER. ERNEST LINCOLN SAGE, Newton Center, Mass.
1,136,827. FAN-BLOWER. WILLIAM J. MONTGOMERY, Jeannette, Pa.
1,136,877. CENTRIFUGAL BLOWER AND OTHER CENTRIFUGAL MACHINE OF A SIMILAR NATURE. THOMAS HENRY COLLETT HOMERSHAM, Bradford, England.
1,136,890. VACUUM CLEANING-MACHINE. GEORGE BRAND, Brooklyn, N. Y.

APRIL 27.

1,136,923. PNEUMATIC PIANO-PLAYER. HOLDEN P. BALLOU, Hartford, Conn.
1,136,957. ROTARY COMPRESSOR. CARL F. HETTTINGER, Boston, Mass.
1,136,968. PNEUMATIC CUSHION. CHARLES W. MCDADE, Moorhead, Iowa.

be etched so that said plate will be maintained in a fixed position submerged in the etching fluid with the face to be etched downward, and means for effecting a distribution of the air in the etching fluid such means being located beneath the plate to be etched.
1,137,463. BLOWER SYSTEM. CHARLES W. E. CLARKE, New York, N. Y.
1,137,488. SIPHON ATTACHMENT. FRANCIS K. HYDE, New York, N. Y.
1,137,575-6. AUTOMATIC AIR-ESCAPE VALVE FOR RAILWAY-BRAKES. SAMUEL CHENEY, Wickepin, Western Australia, Australia.
1,137,627. FENDER. WALTER H. JENNINGS, Smithfield, Pa. Filed Aug. 12, 1914.
1,137,696. BURIAL-CASE. GEORGE L. CAMPBELL, Williamsport, Pa.
1. A burial vault comprising a housing, a closure hermetically sealed thereon, said closure being provided about centrally with a cavity and also having a valve seat in the bottom of said cavity, a valve mounted in connection with the seat in the closure, means to limit the outward movement of said valve, and at the same time permit air to be extracted from the housing, and means applicable to the cavity in said closure for sealing the valve in its seat after the air has been extracted from the housing.
1,137,701. AIR-BRAKE APPARATUS. FRANK S. CRAVENS, Olive Hill, Ky.

Cooper Gas Engine Driven Compressors



Single Tandem Double-acting Cooper Gas Engine, driving cross connected Air Compressor Cylinders, in the power plant of The Ralston Steel Car Company, Columbus, Ohio

Insure
Cheap Air
Dependable Service

The unit shown here delivers 1,740 cu. ft. of air per minute at 100 lbs. pressure. It has been in operation 22 hours per day for two years without losing a minute for adjustment or repairs

Write for Bulletin No. 54 showing recent installations

THE C. & G. COOPER COMPANY, MT. VERNON, OHIO

Copper-Brazed
Compressed Air Tanks

are guaranteed to

Hold Air Indefinitely

without loss of pressure

A series of tests, conducted entirely by disinterested experts, has proved beyond question that our **copper-brazed seams and joints are actually the strongest parts of the Tank.**

Manufactured only by

Wm. B. Scaife & Sons Co.

FOUNDED 1802

NEW YORK, N. Y.—26 CORTLANDT ST. 221 FIRST AVE.—PITTSBURGH, PA.

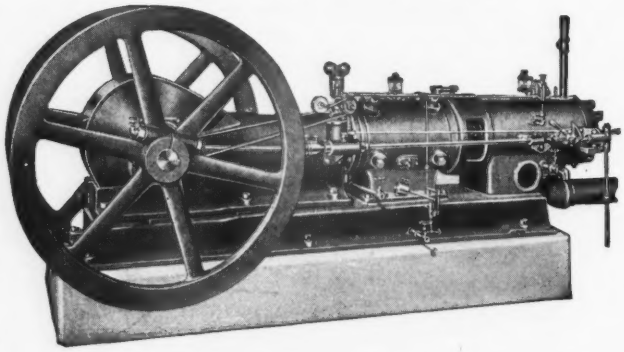
"Chicago Pneumatic" Fuel Oil Driven Air Compressors

200 cubic feet of free air per minute delivered at 100 pounds pressure at a power cost of 9 cents per hour.

Direct Connected,
Self-Contained,
Self-Oiling,
Self-Regulated

Will run on Crude Oil, Fuel Oil, Engine Distillate, Kerosene, Solar Oil or Gasoline.

Send for Bulletin 34-K.



Type N-SO "Chicago Pneumatic" Air Compressor.

Four sizes—70 to 300 cubic ft. per minute free air capacity.

Stationary, Skid Mounted (Semi-Portable) or Truck Mounted for Field Work.

HAS

Valveless Two-Cycle Power Cylinder.
Governed Fuel Injection.
Hot Plate Ignition.
Crosshead Construction.
Perfect Scavenging
Rugged Enclosed Framed.
Balanced Cranks

HAS NO

Valves,
Carburetor,
Magneto
or other Electric
Firing Devices.

1027 Fisher Bldg. Chicago

Chicago Pneumatic Tool Co.

AGENCIES AND BRANCHES EVERYWHERE

50 Church Street New York

JEWETT

24-26 Stone St., New York

SPECIALISTS IN

WASH AND LINE DRAWINGS

Photo Retouching of MECHANICAL SUBJECTS

HALF TONES ZINC ETCHINGS

THE BURY 8-CYLINDER VARIABLE VOLUME AIR COMPRESSOR

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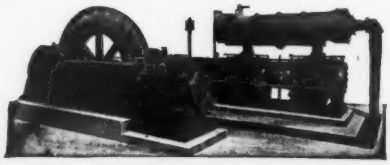

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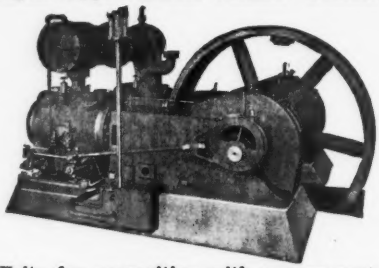

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